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WE are now passing through the most important phase of the great war, and in the submarine raid on merchant shipping is to be found the pivotal point upon which depends the issue of victory or defeat. Fortunately, the Allies, ourselves included, have awoke to the realization of this truth; indeed there can be little question that more thought and effort are being directed to the finding of effective means of combating the submarine than to any other element of the great struggle. Evidence of this is seen in the amazing number of letters which are being received by the Editor, most of them suggesting more or less ingenious devices of an anti-submarine character; and many of them asking for information as to the details of torpedo and submarine construction. A similar flood of letters has been descending upon the Naval Consulting Board and a considerable volume is reaching the offices of the steamship companies and the marine insurance companies.

Now all of this activity is most admirable, and it may well happen that the effective answer to the submarine will come from some citizen who has never had anything to do with the sea or ships and who, looking upon the problem with a mind absolutely free from prejudice and untrammeled by any of the conventions of the technically-trained man, hits upon some line of attack which will prove to be thoroughly effective. Unfortunately, and inevitably, there is a large amount of repetition, and probably thousands of people are expending their efforts upon one and the same device, or are working along lines which have long ago been proved by actual test to be impracticable or barren of results. Furthermore, many of the devices which are sent to us are impracticable, because the correspondent did not possess sufficient knowledge of the principles which control the operation of the submarine and the torpedo, or of the conditions which prevent the application of certain forms of protective devices to ships which have to encounter the heavy storms of the Atlantic and the Mediterranean Sea. This activity is to be encouraged, but it needs direction and information. Therefore, we have decided to publish a series of articles in which we shall give detailed drawings of a submarine and a torpedo, with a full description of their methods of operation, their weight, speed, power and radius of action. These articles will be followed by others, showing some of the typical methods which have been suggested, both for the protection of shipping and the capture or destruction of the U-boat. The first of these articles, a reprint from our issue of August 7th, 1915, is probably the most complete paper on the up-to-date torpedo ever published.—EDITOR.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Protective Pessimism

AN overconfident optimism on the part of the Allies has been one of the main causes of the prolongation of the war. The Battle of the Marne was heralded as the beginning of an imminent breaking down of German confidence, morale and organization. The Russian invasion into Eastern Prussia was the opening phase of a sweep of conquest which was to end in a few months with the march of the Russian hosts through the Unter den Linden to the Kaiser's Palace. With the object lesson of the rape of Belgium before their eyes, it was certain that Greece, Bulgaria and Rumania would league their forces with those of Italy and roll resistlessly up the valley of the Danube to lay siege to the Austrian capital.

And since Great Britain held all the maritime highways of the world in her grasp, and the German fleet had fled incontinently to Kiel and Wilhelmshaven, there to be shut in by a merciless blockade, was it not certain that the despair of the beaten armies at the front would be answered by the cries of a starving people at home? And even if the armies should have the "will to conquer," how could they fight when no cotton was to be had for powder and no copper for shells for the guns.

And as for the Turk—well, he was "all in" as the result of the Balkan wars, and his alliance with the Central Powers simply spelled his early and crushing defeat, to be followed by his elimination from the map of Europe and banishment to the deserts of Arabia.

And so forth and so on.

We are wiser now; and after nearly three years of war it is time for the Allies to season this perilous optimism with a wholesome and corrective dash of pessimism. For there is a certain pessimism, which in the presence of a great crisis such as this, is one of the surest secrets of success.

In any great venture that is beset with possibilities of disaster, the wise man is he who always assumes the worst—not despairingly, but rather with the determination that he will make his dispositions as though the worst were sure to happen, and through it all keeps his courage and resolution fully keyed up for the emergency. Here is a pessimism which is healthy, stimulating and, to our thinking, one of the surest guarantees of success. If the worst does not happen, the situation is just so much improved, and the dispositions that we have made are so much the more certain to be adequate and effective.

In no phase of the war has this point been verified so emphatically as in the submarine attack on merchant shipping. Had the Allies assumed the very worst possible conditions and made beforehand the necessary provisions for meeting them, the losses during the past three months could have been cut in half and the Germans would not have come so near to making good their threat.

So long as the German U-boats were of limited size, speed and radius of action—conditions which obliged them to operate within reach of their home ports—the British were able to extemporize means of attack which were fairly well adequate. Submarines began to be sunk by gunfire, entangled in nets, and captured, with the result that immediately a wave of optimism swept through the Allied countries, and the menace was declared to be not serious and so well in hand that there was reason to hope that it would be totally suppressed. Now this, as we have learned by bitter experience, was an exaggerated optimism, which saw only the things that it wanted to see and closed its eyes to those very serious possibilities of an enlargement and extension of submarine warfare which have now taken place.

An attitude of healthy pessimism would have recognized in the North Sea and Irish and British Channel depredations a sinister hint as to what Germany could accomplish if she threw overboard all moral considerations and bent her whole energy to the construction of a fleet of deep-sea submarines for a wholesale and unrestricted attack upon the shipping of the world.

That very able naval critic Arthur Pollen, months before Germany began to run amuck, did actually warn Great Britain in a series of articles that, in view of the possibility that Germany was meditating just such a course of deviltry, Great Britain should at once begin to arm all of her merchant ships with guns of large caliber, and multiply her fleet of seagoing patrol boats for service off the Allied coasts.

Pessimism without prevision and provision is of course always to be deprecated; but there is a true pessimism, wise, far-sighted and intensely practical which is at once altogether protective and stimulative. It is for us to learn the lesson of our Allies' mistaken optimism; and we should here and now begin to organize our anti-submarine campaign upon the assumption that the U-boat menace will increase rather than diminish as the months go by.

The National Peril of Platinum Jewelry

SO essential is that silvery metal, platinum, in the manufacture of various devices of warfare and in our chemical industry that much attention is being given to the available supply at this time when we are preparing to take our place with the Allies in prosecuting the war to a successful conclusion. And it is not to be wondered at, then, that the question has been asked, Shall we abolish platinum jewelry during the war? and that an affirmative answer has been given by the very parties in a position to reply—the jewelers.

Men engaged in our budding chemical industry and the public at large will be pleased to learn that the Platinum Committee of the Jewelers' Vigilance Committee has passed resolutions which have been presented to the Secretary of Commerce, in which they have shown a most patriotic attitude in recommending to the jewelry trade that the use of platinum in bulky and heavy pieces of jewelry be discouraged, and that jewelers also discourage the use of platinum in all non-essential parts of jewelry, such as scarf-pin stems, pin tongues, joints, catches, swivels, spring rings and ear backs, where gold would serve equally well. Considering the fact that platinum is essential to the production of many of the munitions of war and that it is absolutely necessary for the development of our growing chemical industry and for the development of our chemical knowledge, this action of the jewelers is to be highly commended; for it is bound to be a great aid toward discouraging the unnecessary use—the misuse is the more proper word—of platinum. This action will undoubtedly be followed by a drop in the price of the metal and an increase in the stock available for the use of the Government and our chemical laboratories and our industries.

The jewelers should be credited with the highest patriotic motives, for they will undoubtedly yield up important profits by declining to encourage the undesirable personal adornment and ostentatious display of wealth which is the chief reason for the use of platinum in such articles as watch-cases, solid platinum rings, bracelets, mesh-bags, and so on.

The needs of the Government itself will undoubtedly be met during the war with great sacrifices. While the Government uses comparatively little platinum, the sulfuric acid industry, especially the strong acid used in the production of high explosives, is dependent upon it; and the high price of the metal makes it almost prohibitive for scientific research. No American man or woman, surely, will wish to feel that by wearing platinum he or she is interfering with the development of the country's industrial and scientific standing, but such is inevitably the case. For this reason every measure tending to decrease the amount of platinum stored up in jewelry is bound to be of direct assistance to our Government and our industries in carrying the present war to a speedy and victorious conclusion.

Farming as a Spare-Time Occupation

EAGER to respond to President Wilson's appeal for the cultivation of every inch of available ground in order that the threatened world famine might be averted, even New Yorkers are now "doing their bit," or, to use the American equivalent for the more familiar British war slogan, "coming across."

Farming and New Yorkers are hardly companion words; for in a city where land is considered in terms of square feet instead of acres it is evident that there is little opportunity for the cultivation of the soil. Yet purely through patriotic motives, and in response to the appeals of the public, many wealthy landowners of the city have turned over their undeveloped property to those wishing to engage in farming on a small scale. Thus an appreciable amount of ground has been made available to the people of our largest city, who have not been slow in grasping this unusual opportunity.

The general practice in New York city is to arrange the unimproved land available in each section into fields or "zones," under the management of a committee. In one section, for instance, there may be as many as eight fields or zones, operated by the local Garden Community. Each zone is under the supervision of one man who is responsible for the progress of the work, as well as the behavior of the workers. The land is plowed up, and in order to defray the expense of this work it is the custom to charge each tenant 25 or 50 cents, although in some cases the expense is borne by a philanthropic individual. The zones are divided into standard-sized plots, the dimensions depending upon the supply and demand. However, 20 by 40 feet and 20 by 20 feet appear to be the most favored sizes. The plots, neatly laid out, can be reached by paths which cut up the field into a veritable checkerboard pattern.

The Department of Parks, too, is aiding in the farming movement, and is preparing available land for people expressing a desire to engage in this work.

New York's amateur farmers are satisfied to confine their efforts to the usual run of garden truck produce—carrots, beans, peas, radishes, corn, beets and so on; moreover, the more daring of them have even attempted to cultivate potatoes on their small patches. And if hard work is a prerequisite to success, the community gardens should yield abundant crops during July, August and September, when the harvest is due. Indeed, every morning before eight o'clock, and every evening after business hours, man, woman and child turn out on the tiny farms; and Saturday afternoons and Sundays, which have heretofore been set aside for baseball and other sports, are now devoted to farming.

That the crops shall be reserved for those who are entitled to them is one of the duties of the newly-formed Home Defense guard, whose members watch over the community gardens during the night. There is little danger that unauthorized persons will raid the gardens and rob those who have toiled for many a day at the arduous task of farming.

New York city is not alone in the present community garden plan, for throughout the country similar organizations are at work encouraging the raising of food by every individual in a position to do so. The plan is an excellent one; it should be followed wherever possible not alone as a patriotic offering but as a matter of personal economy.

Perhaps, owing to their lack of knowledge in this field, the amateur farmers will not have crops commensurate with their expectations. Even so, their work will not have been in vain; for aside from the knowledge gained, which will stand them to good stead in the future, they will have learned the value of food, and our National wastefulness of food will be somewhat ameliorated. At any rate, the work is healthful, particularly to those who have no other opportunity for physical exercise.

Standard Ships

BRITISH shipowners are not altogether satisfied with the public idea about the cargo ships which are being built as the swiftest way of meeting the dearth of shipping caused by the German submarines. First, there is a very strong feeling among shipbuilders that, before constructing the new standard type, material should be provided for the completion of ships already on the stocks. There is a considerable number of ships in various stages awaiting their steel plates, some of them actually standing as they were at the beginning of the war. It is obvious that the real economy would be to finish the ships upon which much work has already been done. Some of these uncompleted ships are intended for faster passages than the standard ships and the shipbuilders' view is that these should be finished at once, purely as cargo ships, and put on the seas, leaving the passenger fittings to be put in after the war.

Regarding the standard ships which are being laid down, not only in the yards accustomed to cargo-boat construction, but in all the big yards, there are two varieties, which, however, are not radically different in type. The speed will be somewhat greater than in the present carriers of corresponding size. They will be the property of the state under the management of the Shipping Controller. They are being paid for on the new system of cost plus a definite profit.

The design was arranged by a conference of shipbuilders with the Controller, and one shipbuilder on the Clyde and one on the Tyne each drew the standard designs for those localities. There are also two varieties of marine engines of the reciprocating, triple-expansion type.

The term standard ship does not mean that all the vessels are identical. It is impossible to carry standardization beyond a certain point. The exactly standard parts will be the frames and sections and angle sections, and this will mean one of the chief savings of time and labor in rolling steel. The plates are not standardized, for their sizes must vary according to the appliances in the different yards for lifting and fitting, and the machinery for punching the rivet holes.

A very big saving will be effected by the standard engines, as they will be rapidly produced, and can be fitted into any ship whenever she is ready. So with the steam steering gear, winches, and other installations, and everything indeed down to the compasses, there will be a constant stream of supply towards the shipyards, and the assembling, fitting in, and finishing is expected to move at a pace that will be a revelation to most shipyards.

Invention

Substituting the Microphone for the Phonograph Sound-Box is suggested in a patent recently granted to Edward H. Amet of Redondo Beach, Cal. This inventor proposes the use of an electrical microphone in place of the usual sound-box, and provided with the conventional steel needle or other suitable stylus. The microphone transmits its variations in current to a receiver attached to the tone arm of the phonograph, which in turn imparts the sound waves to the horn.

A Novel Means for Polishing Small Objects is suggested in the patent recently granted Charles Medgyes of Budapest, Hungary. In a machine for polishing metallic bodies by the agency of small polishing bodies such as steel balls, Mr. Medgyes suggests the use of a single continuous conveyor belt forming with its U-shaped bight a receptacle adapted to receive the small polishing bodies. In order that the small polishing bodies may not escape from the receptacle, the inventor has enclosed the upper pulleys, over which passes the belt, in proper casings. It is understood that a Swiss firm is interested in this system of polishing.

A High-Speed Electrical Interrupter.—Of promising design is the electrical interrupter developed by Stuart Sandreuter of Stamford, Conn., in which he makes use of a disk whose periphery is provided with a plurality of alternate insulating and conductive segments, against which presses a rolling contact which is kept in position by a spring. The rolling contact is placed at the end of a sleeve containing the spring. Obviously, this type of interrupter should be capable of operating at high speeds, and the wear and tear should be reduced to a minimum as compared to interrupters making use of friction brushes.

A Two-Way Valve.—Not unlike a double-throw electric switch, a valve invented by Benjamin R. Guice of Grapeland, Texas, makes possible the connecting of a pipe to either of two other pipes by the movement of a lever. The various members of the valve are arranged in a sort of a Y-form, with the connecting member pivoted at one end so that it may be thrown from one side to the other so as to bring its free end in perfect alinement with either pipe. The movement of the pivoted member is controlled by a lever, and the valve is provided with stops, so that the register between the pipes is automatic and as nearby perfect as possible.

Cigar That Comes With Its Own Match.—No longer will it be necessary for the cigar smoker to fumble about his pockets for a match or to ask his neighbor for a match, for Harry R. Van Deventer of Sumter, S. C., has secured a patent on a method of packing a match with each cigar. Mr. Van Deventer proposes to have each cigar come with a match embedded in the butt end, the match being provided with a waterproof covering which, at one end is twisted into a tail that extends through the butt end so as to be readily pulled out. The idea, although simple, appears to be an excellent one, and its application to the manufacture of cigars would not be costly since most of the work might be done by machinery.

Rotary Tooth-Brushes are receiving wide attention on the part of inventors these days. A number of patents have lately been granted on devices of this kind, many of which are distinctly ingenious and should find a ready market when once the advantages of the rotary tooth-brush are fully understood by the public. Some of these devices depend for the rotary movement upon the tightening and loosening of the grip on a pair of handles, and it appears that the polishing member is exceptionally well suited to reach tooth-surfaces that are wellnigh inaccessible with present tooth-brushes. Furthermore, there appears to be less danger of injuring the gums with the rotary type of tooth-brush, for the reason that few people take the trouble to use the flat tooth-brush properly.

Spectacles for the "Movies."—There has recently been placed on the market a novel form of spectacles intended primarily for use at motion picture performances. These spectacles are provided with opaque shades in which a slot somewhat over an inch in length and about one-sixteenth of an inch wide, is cut. The spectacles are said to eliminate 40 per cent of the flicker, to tone down the glare of reflected light from the screen, and to make the details of the actors' faces more clear; in a word, they tend to relieve eyestrain. A further feature claimed by the manufacturers is that the spectacles produce the effect of a stereopticon, so that the pictures assume greater depth in the eyes of the wearer. Among other use, the spectacles may be employed to good advantage by automobile drivers facing the sun, and by sailors and yacht owners in order to save their eyesight from the sun's reflection on the water, while trappers and hunters can prevent snow blindness by using these new spectacles. The slit-shade glasses, it will be noted, do not change the color of the objects, but cut down the over amount of light rays.

Science

The Natural Resources of Russia.—A monumental work on this subject, in six large volumes, is in course of publication under the direction of a committee of the Academy of Sciences of Petrograd. The volumes will be devoted to (1) the utilization of the force of the wind, with meteorological data, information concerning windmotors, etc.; (2) water-power; (3) artesian waters; (4) useful minerals; (5) plants, with botanical and agricultural data; and (6) animals, wild and domestic.

Rotation Period of Uranus.—In 1912 Dr. Slipher, of the Lowell Observatory, found by spectroscopic means that Uranus rotates in the direction of revolution of its satellites in a period of 10 hours 50 minutes. This determination has recently been strikingly confirmed by Mr. Leon Campbell, who has made a series of photometric measurements of the planet's brightness. The latter was found to vary by about 0.15 magnitude, in exactly the period above mentioned; the variation evidently being due to the unequal brightness of different parts of the planet's surface.

Preserving Conditions for Ecological Study.—The Ecological Society of America has appointed a committee, with Dr. V. E. Shelford, of the University of Illinois, as chairman, on the preservation of natural conditions for ecological study. The Central States will be its particular field of activity. Steps have already been taken by the committee to secure the preservation of Skokie Marsh, near Chicago, and to encourage the establishment of other ecological sanctuaries in the Central States. The society proposes to use its influence to secure the preservation of typical areas of forest, swamp, marsh, lake, dune, bog, mountain, chaparral and desert in various parts of the country.

The Bruce Gold Medal.—The Astronomical Society of the Pacific recently made the fourteenth award of the Bruce Gold Medal, the recipient on this occasion being Prof. E. E. Barnard. This medal, provided from funds presented to the society in 1897 by Catherine Wolf Bruce, of New York, is awarded not more often than once a year "for distinguished services to astronomy." The award is notable for the fact that the medalist is always selected from a list of persons nominated by the directors of the Berlin, Paris, Greenwich, Harvard, Yerkes and Lick Observatories; hence it is one of the highest distinctions that can come to an astronomer. The first medalist was Simon Newcomb, and others have included Gill, Auwers, Schiaparelli, Huggins, Vogel, E. C. Pickering, G. W. Hill, Poincaré, Kapetyn, Backlund, Campbell and Hale.

Dried Potatoes in Bolivia.—A consular report from Bolivia calls attention to the fact that throughout the Andean plateau of that country, potatoes are cultivated at altitudes where even the hardiest grains and vegetables will not grow. The natives have a method of preserving potatoes, which consists of alternate freezing and thawing until all the moisture is removed. The resulting product is known as *Chuñu* and it can be stored for months and even years without fear of deterioration. Pressed into little bullet-shaped pieces, chuñu is universally offered for sale in the markets, and is one of the chief foods of the native population. The same report states that France and Sweden have imported seed potatoes from Bolivia, and suggests that American growers should investigate the merits of the Bolivian varieties.

Local Time on Shipboard.—An important innovation in nautical time-keeping has just been inaugurated by the French Government, and it is likely to be adopted by the other maritime countries. Heretofore all vessels have kept, besides the Greenwich time of the chronometers, some variety of approximately local time, according to which the ship's bells were rung and the watches regulated. A common plan is to set the ship's clocks to true local time once a day, at midnight or noon. When the vessel's change in longitude is rapid the ship's time is, on some vessels, readjusted more frequently than once a day. On the other hand, many coasting vessels keep throughout the voyage the time of the port of departure. The result of such practices is that the time of two passing vessels, traveling in opposite directions, may differ by as much as 100 minutes, at a maximum. M. Lallemand, who discusses this subject in the *Comptes Rendus*, points out that the actual time of events noted by such vessels is often rendered uncertain. "Thus," he says, "it will be almost impossible for historians of the future to fix the exact hour of the Battle of Jutland." Moreover, this antiquated system of time-keeping is incongruous with existing facilities for communicating by radiotelegraphy with places on land where standard or zone time is now the rule. Accordingly, the French Navy adopted on March 25th the practice of keeping on all naval and mobilized vessels the time of the standard time zones in which the vessels may find themselves. To avoid an abrupt change of an hour when passing from one time-zone to the next, the time will be changed during the night preceding or following the crossing of the boundary.

Astronomy

Canada's Great Telescope.—From an illustrated article in *Nature*, by Dr. C. A. Chant, on the new Canadian observatory near Victoria, B. C., it appears that the observatory building and the mounting for the 72-inch reflector, the second largest in the world, are practically complete, but the mirror is not yet ready. It is hoped, however, to have the institution in full working order next summer.

The Ninth Satellite of Jupiter, as previously stated in these columns, is supposed to have a diameter of something like 15 miles. Dr. S. B. Nicholson has recently pointed out that, seen from Jupiter, this satellite at full phase would be between the 11th and 12th magnitude: in other words, an insignificant telescopic object in Jovian skies. For both the eighth and ninth satellites, on account of their great distance from their primary, the perturbations produced by the sun are so large that their orbits are not even approximately elliptical. The orbit of the ninth satellite appears to be a little less eccentric than that of the eighth.

Nova Persei.—This object, which made its appearance as a brilliant first-magnitude star in February, 1901, and then rapidly faded to telescopic faintness, is now a star of about the 14th magnitude, and has been the object of some interesting observations. A few months after its discovery it was found to be surrounded by a nebula, the parts of which underwent movements of almost incredible velocity. In a recent communication to the British Astronomical Association, Mr. W. H. Steavenson states that, having observed considerable variation in the brightness of this nova during 1915, he made several observations during the latter part of 1916, and found the star to be still variable, though less so than the previous year. The range of variation in 1916 was about 0.6 magnitude. The most interesting thing about the nova in 1916 was the appearance of a new nebulosity around it. This was first seen in September, and was about 15 seconds in diameter.

A Brilliant Meteor passed over northeastern Illinois and southeastern Wisconsin about half past eight on the evening of February 5th. Although there was bright moonlight at the time, the moon being within one day of full, the light of the meteor was noticed through the windows of houses by people reading in electrically lighted rooms. According to information collected by Prof. Frost, of the Yerkes Observatory, either direct sounds, or a rumble or jar of the earth, attracted attention at points all along the route of the meteor. Several observers report explosions, which appear to have occurred at more than one point in the route. A false rumor was circulated in the newspapers that the meteor fell near the Yerkes Observatory, and many people traveled long distances in the hope of seeing it. It is significant of the state of public enlightenment that although a great many people who were out of doors at the time saw the meteor and furnished descriptions of it, not one could locate its path with reference to the stars.

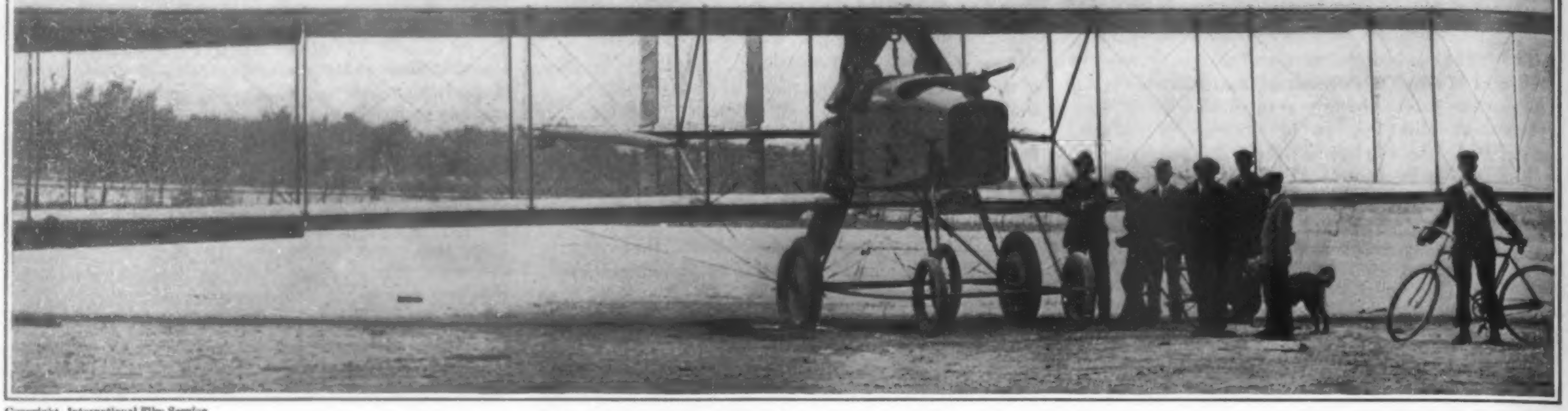
The 100-inch Reflector.—The last annual report of Mount Wilson Observatory contains the interesting news that the mirror of the 100-inch reflector—much the largest telescope in the world—is now completed and silvered. Its clear aperture is actually almost 101 inches; the thickness at the edge is 12.75 inch; and the mirror weighs nearly 9,000 pounds. At the center, where the difference is greatest, the depth of the finished paraboloid differs from that of the nearest spherical surface (to which the glass was brought in preparation for parabolizing) by almost exactly 0.001 inch. In silvering, 35 gallons of distilled water were required to fill the concavity, and to this were added 9 gallons of dilute silver solution and 9 gallons of dilute reducing solution. The deposition of the silver required 15 minutes. The dome for this giant telescope is complete and painted, and the mounting was in course of erection at the end of the year. The operation of the telescope and dome will require the use of 35 electric motors.

Colors of Double Stars.—In *Popular Astronomy* for February, Prof. W. H. Pickering publishes a notable paper on "The Sixty Finest Objects in the Sky," a handy guide to the most interesting and attractive celestial objects visible with the telescope. In discussing double stars the author remarks that their colors depend somewhat upon the size of the telescope. In the older works on astronomy different brilliant colors are assigned to these stars; Webb, for example, in his "Celestial Objects," mentions red, green, blue and purple. The fact, is however, that with sufficient light all stars are either white or yellow. When the aperture of the telescope is diminished and the light thus reduced the white stars turn blue and the yellow ones red, while the intermediate ones are colorless or grey. The colors are further dependent to some extent upon the eye-piece employed. Many star-gazers of the northern hemisphere will be surprised to hear that by far the finest of the globular clusters is in the constellation Tucana, in south declination 72.6, and that this cluster might perhaps be ranked as the finest of all sidereal objects.

Britain's Bid for the Control of the Air

The Airman's Duties at the Front and How He Executes Them

By Lieut. G. L. Faulkner of the British Royal Flying Corps



A typical battleplane of the Allied air fleet. This machine carries three men and is armed with a rapid-fire cannon of small caliber

HOW the British airmen coöperate with the other branches of the army is told in this article, the third and concluding one of a series, by the author, a Canadian airman, who has now returned to France after spending some time in the United States. The facts given are those of the author, who has had ample opportunity to study actual fighting tactics at first hand. In previous issues Lieut. Faulkner has told us something of the training of the British airmen, as well as how British aircraft production has kept pace with the demands of the war.—EDITOR.

MUCH was expected of the aeroplane before the present war. That the aeroplane would play the rôle of super-scout was evident; and, while ante-bellum experiments along the lines of bomb-dropping had not been very successful, it was freely predicted that the next great war would witness the bombardment of fortresses and cities from the skies. All this has come to pass. In addition, the aeroplane has become a fighting unit, combatting similar machines in the air and attacking troops on the ground with its deadly machine-gun fire. Surely the most roseate expectations have been far exceeded by the aeroplane of the present—a new realm of warfare has been discovered.

The Sentries of the Skies and the Night Raiders

For the present the Entente forces hold the control of the air; at least in-so-far as it is possible to hold the control of the air along a front of several hundred miles. For by this term is meant aerial supremacy the greater portion of the time; and when the term comes to be analyzed it proves to be only a comparative one. It is always possible, no matter how strong one may be, for the enemy to concentrate a great number of machines at a given point and become undisputed master of the air until one has the opportunity of bringing up a sufficient number of machines to offset the enemy's concentration. It is for this reason that the control of the air on the Western front has in the past been in doubt so many times, especially when the Germans momentarily succeeded in concentrating not only a vast number of units on a given section of the line, but their best airmen.

However, to maintain their aerial supremacy along the Western front taken as a whole, the Entente armies employ huge flotillas of aeroplanes operating up and down the lines at a height of 6,000 feet for one patrol and 20,000 or 23,000 feet for the other. It is the duty of the higher patrol to prevent German machines from coming over the lines at great heights and sweeping down on the unsuspecting patrols flying many thousand feet below. Indeed, the purpose of the two patrols is to coöperate in preventing any German airman from crossing the lines and securing photographs and valuable information concerning the disposition of defensive works, artillery, and the movement of troops. The Entente forces on a given front may be moving up troops; they may be engaged in extensive railroad operations; they may be building additional trenches; they may be constructing new gun emplacements—all this they may be doing, yet it is imperative that the enemy be kept from knowing what is taking place in back of the lines so that he will not surmise where the next attack is to be launched. This, in sum, is the military strategy of the modern battle, and the general staff knows very little regarding enemy movements without the aid of the flying corps.

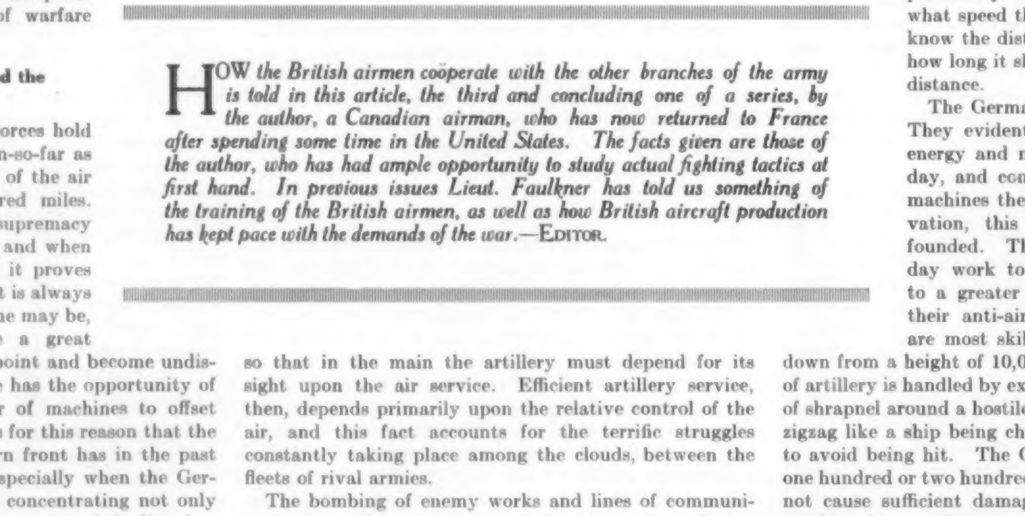
With the increased range of modern artillery and with the introduction of the indirect method of firing, big guns are virtually blind without the aerial observer, unless favorable observation points are available. It is this need for observation points that has brought the kite balloon into existence, and these huge sausage-shaped bags, floating lazily in the air at a height anywhere from 1,000 to 5,000 feet, are comparatively common. But observation points and kite balloons are not stable things: the former are apt to be taken by enemy infantry and the latter are apt to be bombed by enemy airmen, so that in the main the artillery must depend for its sight upon the air service. Efficient artillery service, then, depends primarily upon the relative control of the air, and this fact accounts for the terrific struggles constantly taking place among the clouds, between the fleets of rival armies.

The bombing of enemy works and lines of communication is an important part of the air service's duties. Fifty or more machines will start out in the dead of night over the enemy lines and penetrate 50 to 100 miles into enemy territory, bombing bridges, railroads, munition plants, aerodromes, and military works. The night patrols generally start at intervals; as a rule, ten minutes is allowed between every two machines. The staff commander takes the lead, and by firing a signal pistol which drops signal lights, the machines which follow know whether to turn to the right or to the left and when to drop their bombs. The pilots have their course set before starting, and can tell by the same system as that aboard a boat when a helmsman is running on a certain course for so many minutes, just at what point they happen to be. They know at what speed their machines travel and they know the distance from point to point and how long it should take them to cover that distance.

The Germans do not fancy night flying. They evidently believe in reserving their energy and machines for work during the day, and considering the large number of machines they have lost in artillery observation, this policy is undoubtedly well founded. The Germans concentrate on day work to a large extent, and depend to a greater degree than the Allies upon their anti-aircraft guns with which they are most skillful, often bringing machines down from a height of 10,000 to 12,000 feet. This class of artillery is handled by experts. The guns throw a ring of shrapnel around a hostile machine, and the pilot has to zigzag like a ship being chased by a submarine in order to avoid being hit. The Germans may fire as many as one hundred or two hundred rounds at a machine and still not cause sufficient damage to prevent the pilot from reaching his aerodrome. In fact, a machine subjected to this treatment is almost always hit, more or less; but it is surprising to learn the great number of times a machine can be hit without being seriously damaged. Airmen often return with their machine riddled with holes from enemy anti-aircraft fire, yet they themselves are uninjured. However, it must not be inferred from this that Allied machines are never brought down by anti-aircraft fire, for the truth of the matter is that many of our machines are brought down and the majority of them in flames when the gasoline tanks are penetrated by shrapnel. Not a few of the occupants of such machines are burned to death before reaching the ground.

Daredevils of the Air and Their Favorite Tricks

Both sides have had wonderful pilots, and among the foremost German pilots were the well-known Captain Boelke and Captain Immelmann, both deceased. These two pilots brought down a large number of British and French machines in the course of hundreds of engagements. Boelke was noted for his dive at an opponent from a great height. He would make an absolutely vertical nose-dive from a height sometimes of 15,000 to 20,000 feet, all the while making a speed around 150 miles an hour and firing at his opponent with a machine gun ejecting 600 shots a minute. At other times Boelke would come up behind an opponent and shoot into the tail and through the machine in an attempt to disable the rudder, the observer,



A single-seater high speed British scout machine, equipped with a rotary engine

the pilot and the engine, all at one time. If he missed on the first dive he seldom came up again. This famous German pilot was noted for his quick turns. One of Immelmann's favorite maneuvers, on the other hand, was to allow an Allied pilot to take up a position in back of him—"on his tail"—and just when said Allied pilot was congratulating himself upon his skill in outmaneuvering the German, Immelmann would pull the nose of his machine up until he would nearly stall, and then rapidly pull it into a nose dive and turn almost within his own space, with the result that soon he was "sitting on the tail" of the Allied pilot and sending him to his doom before he had an opportunity of recovering from his surprise. By maneuvering in this manner Immelmann was able to outmaneuver and gain what the pilots call "a bead" on his opponents, and deliver the *coup de grace* in the form of a shower of lead.

In justice be it said that Immelmann and Boelke were perhaps better known than any other aviators in the present war, either in the German or Allied camps. The Germans idolized these two intrepid airmen. It was a boast in the music halls and cafés of Berlin that certain types of British machines manufactured in England by the Royal Aircraft Factory were "fodder for the Fokker," especially when the Fokker was piloted by either of these crack airmen. In a previous article I pointed out the folly of allowing politics to mingle with aeronautical matters. I pointed out the fact that by the time the Royal Aircraft Factory machines were sent to the front they were already antiquated by the progressive German

occasions was called the "Red Devil" because the nose was painted red. The Nieuport Bullet, a French machine equipped with a LeRhone engine, the Sopwith Pup and the DeHaviland Scout, both British machines, and the Spad, a French machine making as high as 145 miles an hour, have also been used by Captain Ball on different occasions.

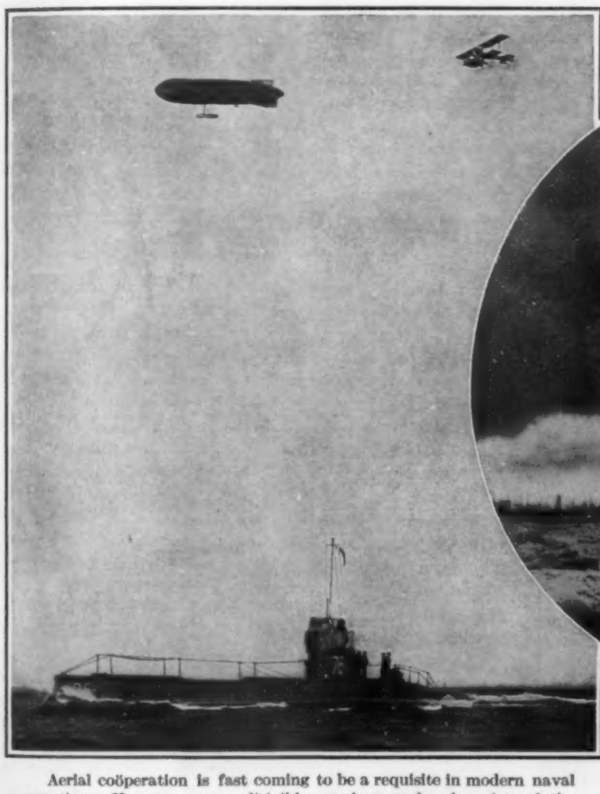
Wandering off by himself and seeking out the enemy in back of the latter's lines appears to be Captain Ball's favorite method of fighting. On occasions he has swooped down to within a relatively small distance from the ground and attacked infantry in camps far in back of the fighting lines; and he has sought out and fought German pilots lurking in cloud banks. He has attacked enemy patrols single handed—in some instances as many as ten machines, and has had hundreds of miraculous escapes. British pilots are wont to believe that Captain Ball has a charmed life; indeed, he has been known to have had three forced landings in a single day as results of aerial battles, each time going up again as soon as another machine could be prepared for him. The Germans have set a price on his head; but so far he is still at large.

The Lafayette Escadrille, composed of Americans, has brought down over thirty enemy machines. The young pilots of this corps are to be commended for their splendid spirit in going to France to engage in such hazardous work, especially those who have already sacrificed their lives for a cause which they so nobly espoused. Nieuport machines are used by the escadrille.

airmen—beneath them, all around them, and above them. For three hours, at times, the airmen must endure this intense bombardment, and there is no telling at what moment the tail of the machine or some other vital part may be blown away, or when the machine may become wrapped in flames. The work is most dangerous and nerve-racking, and most of the pilots stutter after going through this ordeal. Some have been known to be unable to screw a nut or a bolt, due to nervous ailment.

Photographs That Pave the Way for an Offensive

Thousands upon thousands of photographs are made of enemy positions prior to an important offensive, and the information contained in these photographs is invaluable in the preparation of maps and in the development of the battle plans. To accomplish this all-important work a number of aeroplanes, sometimes five and sometimes more, are sent up to take photographs behind the enemy's lines. The camera-carrying or reconnaissance machine is generally in the center with machines on either side, flying 500 feet above the one in the center. Then there are two following up the rear, 1,000 feet above the ones in front. This arrangement of varying heights is carried out so that in the event of an enemy attack, particularly a nose dive at the reconnaissance machine, with the object of destroying the thousands of photographs that may be of vital interest to the general staff, the convoys can rush up and engage the enemy before he has had an opportunity of carrying out his attack.



Aerial coöperation is fast coming to be a requisite in modern naval practice. Here are seen a dirigible, seaplane and submarine of the British navy engaged in special maneuvers.

Copyright, Underwood & Underwood

With fast single-seater Nieuport scouts such as this one, the Lafayette Escadrille—American volunteer airmen in the French service—has distinguished itself.

While returning from a night flight this British machine collided with the tree. The pilot, fortunately, was uninjured; but this serves to indicate the danger of nocturnal flights.

Entente aircraft over the sea, "No Man's Land," and in back of the lines engaged in naval and military scouting, and in night-flying practice

aircraft builders. For aeronautical progress moves fast on the Western front: a machine today may be without rival; six months hence it is suicide to employ it against the enemy.

In all, Immelmann and Boelke accounted for something like eighty Allied pilots, the majority of whom were flying government-built machines that were absolutely useless in warfare of this kind; indeed, these machines were called "suicide shells" by the officers of the British flying corps. They were so constructed that the machine-gun mounting was in a position where it was absolutely impossible for the pilot to fight unless he were running away from his opponent. Little wonder that the two crack Germans delighted in combatting the unfortunate occupants of these machines! It was nothing less than criminal to send this type of machine to the front; but the Royal Aircraft Factory—a factory composed of political "heelers" and "grafters"—was allowed to flood the Western front with this type of machine. Here, then, is a warning to the United States, or rather a lesson; for with its entrance into the war at a time when the Allies have been fighting close on to three years, the latest belligerent has an opportunity of learning the errors that have been made and how their repetition may be avoided. In fact, it is with this idea in mind that the Allied commissions have come to America.

Captain Ball, the famous British pilot who has been decorated with the highest military orders of Great Britain, Russia and France, has to his credit over fifty victims. The machine he used on a large number of

Directing Artillery Fire from the Sky

Artillery observation is one of the most important branches of the service. So indispensable is the airman in connection with modern artillery that a noted authority recently stated that if one side had aeroplanes while the other had none, the war would have been over in six months.

Pilots and observers work in conjunction with a battery. They arrange beforehand with the general staff just where that battery is to operate. If they are ordered to seek out an enemy battery that may be lodged at the end of a wood or in some concealed position, the pilot manouvers about under the instructions of the observer until the battery is spotted, whereupon its position is signalled back by means of a wireless set to the battery commander. After notifying his battery to open fire, the observer hangs over the position at a height of say 6,000 feet to avoid the trajectory of the shells passing underneath his machine; and as the shells burst near the position under fire, the observer notifies his battery how short or how far ahead, or how much to either side the shells are falling. The observer then orders the pilot to proceed over the next position, and the operation is repeated. When the work is completed the airmen are ordered to return by means of signals in the form of canvas strips placed on the ground.

All the while the observer is directing artillery fire his machine is being subjected to intense bombardment by anti-aircraft guns, which are firing shrapnel shells by the hundreds. Flying fragments of shrapnel are all about the

So the fast little "vipers" or "maggots" as they are called, guard the reconnaissance machine from overhead, underneath and the sides. They act in a capacity similar to the diminutive torpedo-boat destroyers which form a screen about a dreadnought in a submarine-infested sea.

The convoys are looking for trouble and usually have no difficulty in finding it, particularly when a swarm of fifteen to twenty German machines returning from a raid, swoop down from a height of 20,000 feet on the scouting fleet. A general alarm is given and the machines at the rear close in to protect the reconnaissance plane, whereupon a free-for-all fight ensues. Sometimes several of our brave fellows may be left behind while the reconnaissance plane endeavors to escape; and, depending upon the fortunes of the combat, one or more of them are shot down by the preponderant enemy. The enemy has a trick of coming up behind and attacking the rear machines so as to cut them off from the machines in front, which obviously results in each machine being overpowered; whereas if the machines were fighting as a squadron they would have a better chance of coming through. By means of a signal pistol which throws smoke shells in the daytime and lights at night, the machines are instructed to close in. Paramount is the necessity of bringing the reconnaissance plane back to the lines, and to this end the convoys are sacrificed, if sacrificed they must be.

All this, briefly, is in the day's work of the modern military airman.

Strategic Moves of the War—May 23d, 1917

By Our Military Expert

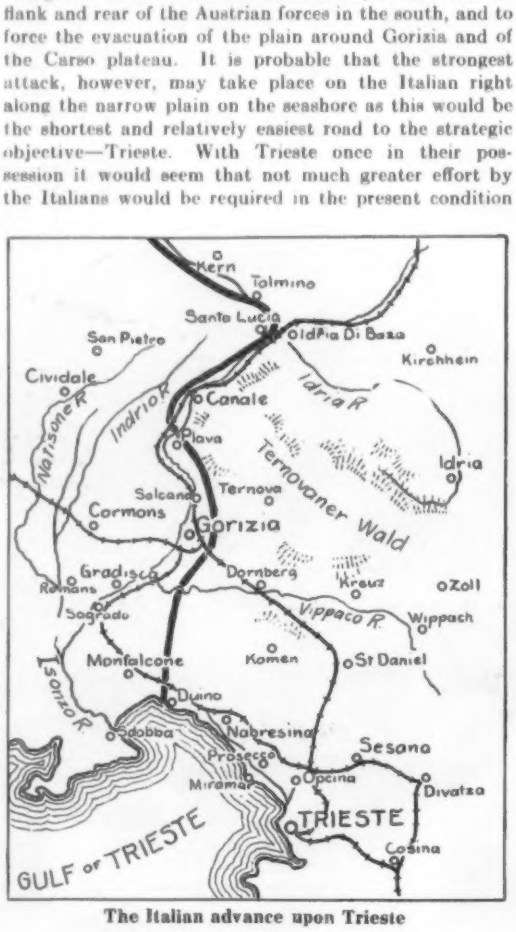
THE terrific fighting in the Arras lines in and around Bullecourt, near Croisilles, ended on May 17th, when the British, after a most desperate struggle lasting for two weeks, finally obtained possession of the village or rather of its ruins. This success consolidated the other positions won on the original Hindenburg lines. By continuing the advances in the direction of Riencourt they threatened also the junction of the old line with the Drocourt-Quéant line near Quéant. In fact, a strong push forward from Bullecourt and from the north wrested additional trenches from the Germans and has practically broken up the Hindenburg or Oppy line so greatly that it cannot be relied upon to hold as a defense system anywhere north of Quéant. Bullecourt is less than two miles from Quéant so that the British now have a firm grip on an extended section in this region. This all means that south of the Scarpe River, the Germans have nothing to oppose to the British, except hastily improvised field trenches, until the Drocourt-Quéant line is reached. North of the Scarpe they still hold Oppy and Fresnoy; but the capture of Roeux by the British and gains farther north threaten even these towns. A retreat by the Germans to the Drocourt-Quéant line seems unavoidable; this line is undoubtedly the last defensive system in front of Douai. That city is one pier of the bridge which in connection with Laon, is the defense of this part of France; the pier once taken, a retreat to the Belgian frontier follows as a matter of course. A withdrawal of the Germans on the Arras front would lead to the abandonment of Lens. That city is the center of the coal district and of the coal mines, the destruction of which must now be almost complete. Appearances also indicate a retirement on the British Arras front. From the reports of observers on that front there is every indication that another German retreat is imminent; the desperate counter-attacks that they have carried out can be intended only to mask retirements on other parts of their lines. Many fires have been noticed in the villages back of the German lines and St. Quentin has apparently been burning for days.

By the withdrawal mentioned above, the German commander would occupy stronger defenses than at present; but such defenses would be the only ones that would protect the important cities of Douai and Cambrai. To the east of St. Quentin there are strong hill positions that the Germans could still hold. Any withdrawal toward Laon would probably stop at Anizy and would be the extension of the line to include the plateau and forest of St. Gobain.

As the struggle stands at present on the Western front, it seems to be a general battle by which each hopes to exhaust the reserve forces of his adversary and thus to diminish his fighting power later. If this be true then the German commander is certainly getting the worst of it; for his losses, by being forced to assault, have been much heavier than those of the British or the French. Everything indicates that when a retreat is once begun, it will extend even to Laon, the French strategic objective.

On the French front proper, the Germans have kept up the heavy pressure on the left, between Laon and Soissons, while the French have been widening the wedge that they are pushing forward between Rheims and Laon. Assaults by the Germans on the Chemin-des-Dames and around Laffaux and Laffaux Mill have resulted in little advantage except to add to heavy losses of men. The flooding by the Germans of the valley of the Oise above and below St. Quentin has proven to be a very serious obstacle to any attempt at an offensive. South and east of that city, the flooding of the stream has been carried out by opening the Cambrai-et-Oise Canal into the river thus converting all low ground, about twelve miles or more in length, into a marsh. Such a condition has prevented any advance upon Laon, from the west, and has even hindered operations against the forest and plateau of St. Gobain, the bulwark protecting Laon in that direction. This is a natural fortress about ten miles square and a frontal assault would have been a serious matter. But, except for the flooding of the river, it could have been turned without much difficulty and the French would have then found themselves in the plain around Laon. The twelve miles of marsh and flooded ground are a strong adjunct to Hindenburg's defense and cannot at present be ignored.

The spring offensive on the Italian front began a few days ago and is now rapidly approaching a climax. It is upon a thirty-five mile front extending from Tolmino, on the north, along the Isonzo River to the Adriatic. The Italian troops have taken the fashionable watering place of Duino at the head of the Gulf of Trieste and are now only twelve miles from Trieste itself. While this move of the Italian forces can be viewed as a part of the general Allied offensive that takes in the Western front and the Balkans, the Italian commander has evidently in view an objective—the capture of Trieste itself. This capture would have happened last year, had not the Austrians held so firmly to the hills around Gorizia. By breaking through at Gorizia, the Italians could then move southeast and strike Trieste from the rear. The strategic plan of the Italian commander is evidently to extend his north flank so that it can cover his center on the Carso plateau and thus enable him to strike hard on that plateau also. This is also shown by the heavy artillery fire from Gorizia to the sea, for once the north or left flank of the Italian army is thrust forward enough to ward off all danger from the north and east, infantry attacks will be made on the Carso. The Italian lines here extend some distance to the east and, if carried far enough, can cut all railroads leading into Trieste. The great Austrian seaport could then be taken at leisure and whenever desired. As it stands at present, the object of the strong offensive now in progress is to straighten their lines across the Isonzo, to uncover the flank and rear of the Austrian forces in the south, and to force the evacuation of the plain around Gorizia and of the Carso plateau. It is probable that the strongest attack, however, may take place on the Italian right along the narrow plain on the seashore as this would be the shortest and relatively easiest road to the strategic objective—Trieste. With Trieste once in their possession it would seem that not much greater effort by the Italians would be required in the present condition



The Italian advance upon Trieste

of the Austrian army to open a path down the peninsula to the great Austrian naval station—Pola—or across the same peninsula following good roads and supply railroads to the other principal seaport of Austria—Fiume. So far the fighting along the Isonzo has been very heavy, with consequent great losses to both sides—notably to the Austrians who have also lost, in addition to strong positions, a number of guns, small arms and ammunition. Comparative quiet at present prevails on this front, as the Italians are consolidating their positions on the new ground gained. In the Trentino, new attacks that have been repulsed have been made by the Austrians at various points, evidently with a view to divert the Italian Staff from its main objective on the Gorizia front. The strong offensive of the French and British in the west has no doubt been made for the purpose not only of drawing off German troops from the Russian front, but also of aiding in the same way in helping the Italian forces in their operations.

And now the great question comes to the front—"What will Russia do and will there be, soon, a Russian offensive like that of Brussiloff last year?" Germany has tried to draw all possible profit from the Russian situation and has undoubtedly greatly weakened her forces along that front. As if to forestall the effects of this, she has recently struck in considerable strength at points widely separated on the Russian front as if it were to make up by the force of her attacks for the thinning of her lines and for her reduction of defensive power. The unofficial armistice that has prevailed for some time appears also to have ceased. The resources in man power of the Germans must be strained to the breaking point, and that point would undoubtedly be reached by a vigorous drive by the Russians, such as was made last year. Austria can help but little, if any; no doubt she is at her wits' ends to provide against the strong Italian offensive on the Isonzo.

Bulgaria and Turkey have too much on their hands in Macedonia, Mesopotamia, and Palestine to be able to help at all. It would therefore appear as if an end might be made of Germany's offensive power this year, if the Entente Allies can coördinate their advantages on all the fronts; for, if reports can be believed, the Germans are certainly beginning to feel the effects of their enormous losses and heavy sacrifices of men. Another consideration comes in that may soon alter conditions—a race between time and famine, where the margin of safety as regards the present supply of food and its replenishment from this year's crops is very small. Already the potato situation has become serious and the bread supply seems scanty enough, if reports can be believed. With the customary German forethought, it is said arrangements have already been made to rush the crops, especially of oats and wheat, from the districts as they are gathered, and to turn into flour as early as practicable everything that can be obtained.

Having failed to make friends of the soldiers and leading men that the recent revolution put in power in Russia, the German commanders on the Eastern front threw off the mask and made a violent attack on the Russian lines in the vicinity of Vladimir-Volynsky and Kovel, in Galicia. The Russians speak of it as a "sweeping assault" that was made by the Germans in mass formation. The attack was strongly pressed, but was successfully resisted at each place. Attacks have also been made on the Russian positions near Mitau, on the Riga front, and on the Rumanian border.

In Macdeonia there has been considerable activity all along the lines from Lake Presba on the west to the Struma River on the east. On parts of this front the fighting developed the presence of German troops in force, backing up the combined Bulgarian and Turkish forces.

What is the present object of the high command of the Entente Allies on this front can be only a matter of conjecture. The opportunity for any great strategic move to cut off the Central Allies from Constantinople and the east practically failed in its purpose when Rumania was invaded and the greater part of that country left, as a result, in German hands. For, today, if the Belgrade-Nish-Constantinople railroad is cut at one or more points, there are several rail and water routes by which Constantinople can be reached and German reinforcements, arms, guns and munitions can be shipped to Turkey and into Asia Minor and Palestine, if desired. If the French commander desires to push north with his columns, he has but few routes over which to move and, over these, the Central Allies can equally as well move south in opposition. One road from the west leads from Monastir via Prilep and Babuna Pass to Koprulu on the Vardar River. The only other road to the north leads from Salonica up the Vardar River following the Salonica-Belgrade railroad to Kropulu, Uskub and farther into Servia. Still to the east there is a road connecting with Salonica and Seres that follows the Struma River to Kustendil and thence to Sofia and the railroad to Constantinople. Whether the Entente Allied commander has with him at present sufficient men for an extended strategic operation to the north is a great question. His strength has been variously estimated at 350,000 to 650,000 men, of all nationalities. But it should be remembered that all supplies come by sea, and the extensive submarine warfare in the Mediterranean must have its effects upon over-sea shipments and service.

As far as can be determined at present, the operations under way on the Macedonian front have in view holding the Central Allies' forces, so that aid cannot be sent either to the Italian or Western fronts, where additional men are so much needed. The Allies must have in view also the keeping up of pressure on Bulgaria where the opposition to the war, never popular in that country, is growing each day, and is building up a party hostile to the German King Ferdinand and to the Germano-Turkish Alliance. It is, too, by no means improbable that Turkey may change sides or at least conclude a separate peace, now that Russia no longer makes a claim to Constantinople. Any hostility on the part of Greece is also a thing of the past, as there are indications that, at an early date, there will be a republic with Venizelos, the Entente Allies' candidate, as its head.

Changes in the Bureau of Animal Industry

TWO new divisions have just been organized in the U. S. Bureau of Animal Industry, viz., the Tuberculosis Eradication Division and the Tick Eradication Division. The former will have charge of the work of testing cattle for tubercular infection; a class of work which has been greatly expanded by a recent appropriation from Congress. The other new division will be devoted exclusively to the work of eradicating the cattle fever tick in the South.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Anti-Submarine Protection

To the Editor of the SCIENTIFIC AMERICAN:

I have been unable to find a satisfactory answer to the question why none of the schemes for protecting ships from torpedoes by means of plates suspended from outriggers, have been considered worthy of trial. So far as I can make out, the authorities have regarded it as so urgent to get the utmost use out of each available ship, that they have been unwilling to sacrifice speed. I understand also that speed itself lends a measure of security which would be sacrificed by resort to such protective measures. Nevertheless, the inadequacy of speed and guns mounted on the merchantmen as insurance against successful attack, has been startlingly demonstrated by the increasing losses during the past fortnight. In view of the rapidly increasing number of submarines in operation, and the quickness with which they can be built, even if an effective means of destroying them is found, it will be a good while before the seas are reasonably clear. Meantime it seems to me, we have got to come to the plan of protective plates or their equivalent, speed or no speed, if we want to have any ships left. A slow ship is better than none.

There are many possible variations in the nature of the shield, such as plates, nets, grids, pads, and deep, flat tanks, and it seems to me that some form could be found which would at most, not more than double the ship resistance. If the resistance is doubled the ship should be able to make about three-quarters of its normal speed. The force required to drive the ship varies approximately with the square of the speed. At the reduced speed, assuming the engines to run at their normal rate, the propeller would exert slightly more thrust than under normal conditions. If half of this thrust is available for the ship (the remainder being required for the protectors) the ship would receive a little more than half its normal propelling force, which should drive it at about three-fourths of its normal speed.

Clearly, any shield should have a smooth surface, with the minimum of irregularities, and should lie parallel to the lines of flow. Since the torpedos are set to run at a depth of 9 feet, it would seem as if a shield extending from 12 to 6 feet below the surface, or, in other words, a shield 6 feet high should suffice. At present the submarines have to make their attacks broadside on in order to stand a reasonable chance of success, so I do not believe it would be necessary completely to enclose the ship, but simply to run a line of shields on either side, carrying them slightly beyond the ends of the ship. Such a system of shields would have about the same surface as that presented by the sides of the ship, taken to a depth of 12 feet. They would, therefore, fall far short of doubling the surface responsible for skin friction, and if they were well designed, they should offer little cutting resistance. For these reasons, I think my allowance of double normal resistance, and three-fourths normal speed, is conservative.

I am not well enough apprised of the workings of torpedoes to reach any conclusions as to what would be the best form of protection, and I am inclined to think considerable experimenting may have to be done before the best form is found, but the following ideas which have occurred to me illustrate some of the many possibilities: If it is considered desirable to try to stop the torpedo without exploding it, a double layer, fine mesh, rope net, covered with painted canvas on both sides to give it a smooth surface, might be worth trying. A grid of horizontal rods or pipes, with just enough vertical members to give it the necessary strength, would offer less surface, and possibly less total resistance than plates. By varying the form of the bars, it could be made rigid, to explode the torpedo, or yielding, not to explode it, according to which seems better. The thin tank would perhaps offer the best protection, and could be built, so that it would not offer appreciably more resistance than a simple plate. The air-space would provide a cushion which would materially reduce the danger to the ship if the torpedo exploded, while some rope nets included between the plates would make it exceedingly difficult for the torpedo to pierce through and reach the ship. The shields of any type would need to be suspended in such a way as to aline themselves with the direction of flow of the surrounding water. Possibly a combination of grids in front, with tanks or plates on the sides, would be the best arrangement.

It seems to me that we should begin at once, equipping the ships leaving our ports with whatever form of shields can be most readily obtained, probably plates, and that the Government should at once undertake experiments, on a large scale, to determine the best form and arrangement of shields. When the best form is found, the temporary shields can be replaced with the better ones.

E. W. KELLOG.

Blockading with Nets

To the Editor of the SCIENTIFIC AMERICAN:

Your leading editorial, relative to netting to stop submarines, in your issue of May 19, 1917, has been noted with great interest by the writer.

My scheme is to use 10-foot mesh, the top and bottom strands of the net to be of 1-inch steel cable, with 1-inch diagonals, the meshes themselves being formed of ½ or ⅝-inch cable or wire; large mines attached every 50 feet; necessary anchors of special types, and floats. The anchors should be as light as is consistent with just maintaining the position of the barrier, in order that the resistance to vessel striking the net would be as small as possible, enabling the net to give in a flexible manner, and allow the mines to drag back against the vessel. I think your method of attaching a small contact bomb at each intersection of mesh a good idea, provided the large mines every 50 feet, say, are retained.

I have worked out approximate cost of placing my net from the Belgian coast just northwest of Ostend to Lindesnaes, Norway, direct, entirely closing the waterway from surface to bottom of the sea, except in the very deep water just South of Lindesnaes. You will note the greater portion of this distance is occupied by water only 100 feet to 150 feet deep. The entire cost of this work would approximate one hundred million dollars ($100,000,000). This, you will note, is many times greater than your estimate of the cost of installing the net you describe. I believe your estimated cost is very much too low.

I have also worked out the cost of placing my net from Ostend to Lindesnaes via Doggerbank (instead of direct), the depth this way being somewhat less than direct, and the line closer to England, though some miles longer, and costing more than direct.

The next best line I conclude to be from Flamborough Head, on east coast of England, to Lindesnaes. This would leave a considerable portion of the English coast exposed, but would cost less than any other line that can be put across and would be easier to guard and maintain than those from Ostend to Lindesnaes.

The fourth, and shortest, line I have figured on is from Rattray Head, Scotland, to Stavanger, Norway. It would be easier to guard than any of the other three but would leave the whole of the East coast of England exposed. The average depth would be much less than along the line you suggest. The cost would be more than any one of the three above suggested by me on account of the greater depth—and I have figured on nothing less than going to the bottom in every case everywhere except in the extreme deep a short distance off the Norwegian coast. I believe it is best to place a net that will not have to be deepened to stop the deeper diving submarines that the Germans will undoubtedly bring out if it becomes necessary. There is little use or benefit in taking half measures that will have to be increased later, the only proper barrier being the best barrier and nothing less.

I do not consider the cost of $100,000,000 at all excessive, considering the results to be attained. An effective submarine barrier across the North Sea would no doubt be considered by the Allies to be worth many hundred millions, if indeed the value could be measured in dollars.

I have also considered building a barrier of a continuous series of short units of independently laid netting, each unit being complete with mines, floats and light anchors, and unattached to other units, so that there would be offered the least possible resistance to movement when struck by a vessel, thus decreasing the liability of the net strands being broken or cut, and increasing the probability of the vessel carrying the net forward and dragging the mines against the vessel. The cost of this system is practically the same as the continuous single piece or attached net. It was concerning this method that I wrote to Secretary Daniels.

These barriers are feasible and can be placed and maintained, with adequate naval protection, in entirely practical ways.

C. L. COVINGTON, C.E

Boston, Mass.

Bulkheads Versus Torpedoes

To the Editor of the SCIENTIFIC AMERICAN:

There can be little doubt that many vessels have been lost, after being torpedoed, as a consequence of their bulkheads being of inadequate strength and too widely spaced. And frequently a contributory cause is the fact that the bulkheads are often not carried up to the upper decks. That this is so is borne out by the fact that few, if any, vessels designed to carry oil in bulk have been lost as a result of being torpedoed. The bulkheads of this type of vessel are of very strong construction, closely spaced, and carried up to the upper decks in all cases.

It has occurred to me that if the bulkheads of ordinary vessels were strengthened by means of heavy planking, or bulk of timber, and shored up in a manner similar to that employed when salvage operations are being undertaken, and strong, temporary, intermediate transverse bulkheads made of heavy timbers were erected, all bulkheads both permanent and temporary being carried up to the upper decks, that the chances of a torpedoed vessel reaching port, it is true in a damaged condition, would be enormously increased.

I would suggest that the additional bulkheads should be so spaced that, governed by the position of the cargo hatches, the ship would be divided up into compartmnets of about thirty feet in length. Of course, these additions would cost a considerable sum of money, and would decrease the cargo space somewhat, but this would be of small consequence if a ship, which otherwise would have gone down, is saved.

Among other things which do not impair the usefulness of cargo-carrying vessels and at the same time very materially add to their immunity from submarine attack, is the matter of rapid response to their helm. All modern naval vessels have their dead wood, both fore and aft, cut away to facilitate rapid turning. Why not construct all merchant vessels laid down during the war in the same manner? This is especially relevant to the new wooden fleet being built. These vessels with a speed of say fourteen knots, and built upon the well-known turnabout principle, so as to be able to turn in little more than their own length, would be, a sharp lookout being maintained, very difficult indeed to sink by torpedo, and if armed with, say, two 5-inch or 6-inch guns, be altogether too formidable a customer for any submarine to attack while running upon the surface.

I think the above suggestion, in view of the vital importance at the present time of the conservation of ships should, if necessary, be enforced by law.

The owners of the ships could be indemnified for any permanent decrease in earning capacity should vessels thus altered be found to be seriously impaired for ordinary use in peace times.

Washington, D. C. O. J. COOKE.

The Current Supplement

IN these days of stress, when "preparedness" is the watchword in every line of human endeavor, the first proceding is to take account of stock of what we know, and then to study how best to apply and utilize that knowledge. An article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2161 for June 2d, on *The Organization of Thought* is in this direction, and is an analytic inquiry into the nature of science. *The Beginnings of War Machines* describes former-day types of explosive missiles which were the forerunners of our modern hand grenade. It is accompanied by a number of illustrations. *Aviation and Aerography* discusses the construction of aerographic charts, and gives a number of explanatory diagrams. The paper on the *Brownian Movement of Electrified Particles in Gases* is concluded. *Stellar Evolution* treats of the discovery of a missing link in the chain of spectra observations. There are two excellent photographs. *Maintenance of Management* discusses a most important element of waste elimination in manufacturing, and is from the pen of a leading efficiency expert. *The Relation of Lighting to Architectural Interiors* considers a very important element in the designing of buildings of every class. *Indicating Gear for Internal Combustion Engines* describes an apparatus for investigating the working of this widely used class of prime movers, and is illustrated by several drawings. *The Motorcycle in War* tells something of the useful work these little machines are doing in the armies of Europe, and is accompanied by one photograph. *The Mathematics of War* explains in a popular manner the various calculations for ascertaining distance, height, etc., that are constantly employed by armies and navies in active service.

Soapsuds Bandages

TWO European surgeons have recently recommended the use of ordinary soap for the dressing of wounds. Gauze bandages impregnated with a thick fine-grained suds made from pure white soap are employed and the method of making and applying them is so simple that the ordinary housewife can easily add it to her store of "first-aid" knowledge, as described before a recent meeting of the Society of Surgeons in Paris and reported in *Bibliotheque Universelle* (Lavsanne) it is as follows:

From 20 to 40 per cent of white soap is dissolved in warm water which has been sterilized by boiling or distilling. *Tampons* of surgical gauze for cleansing the wound are dipped in this soapy water, which is used for irrigating the wound. The wound is then bandaged with gauze compresses which must be at least a centimeter (about half an inch) thick. These compresses are dipped in the soapy water, then rubbed with the soap until they are saturated, after which they are manipulated to produce a thick white suds, and placed lightly over the wound, then covered with absorbent cotton held in place by tarletan. Essentially the bandage thus constituted is a sort of spongy tissue made of millions of tiny soap bubbles. It is renewed every two or three days, and is said to have the great advantages of calming pain very markedly, of not sticking to the tissues, and of not causing bleeding or suffering when removed. The healing is rapid and the aspect of the scar good.

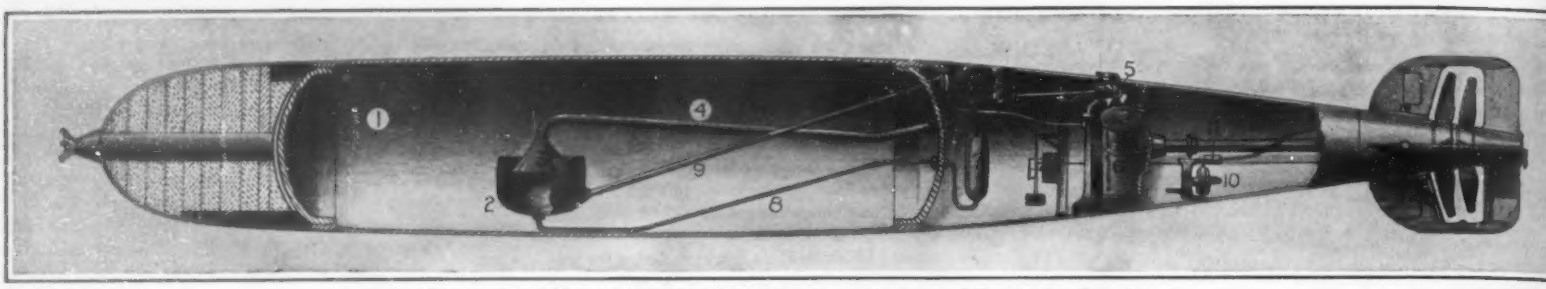


Fig. 1—The old style torpedo with internal superheater and Brotherhood engine

The Modern Automobile Torpedo

The Elaborate Internal Mechanism with Which It Drives and Steers Itself

By Edward F. Chandler, M.E.

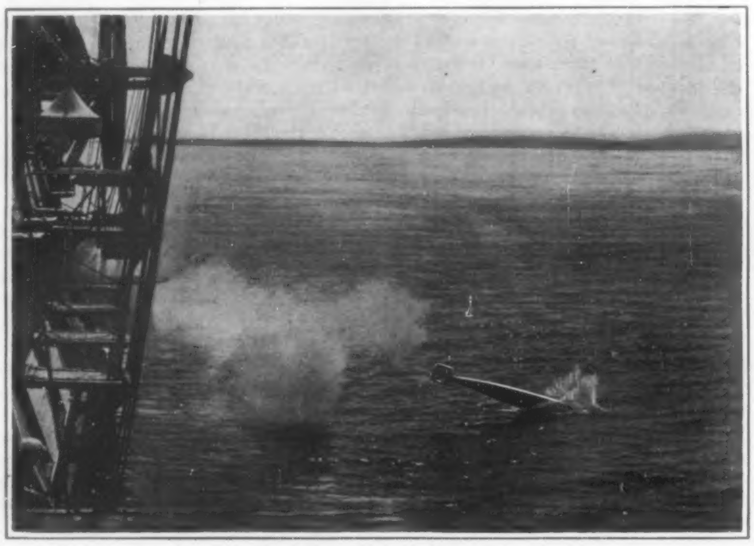
WHEN the torpedo was first recognized as a weapon of war, its effective range was a little over a quarter of a mile. It was essential to get close enough to an enemy to use it. Hence, the light, high-speed torpedo boat was developed. The boats were to be used either singly or in groups—singly at night or when the opportunity was favorable and in groups when it was impossible to escape detection, and several boats would have to be sacrificed in the hope of enabling one, at least, to plant its torpedo in the side of a warship. Then came the torpedo boat destroyer—a vessel fast enough to overhaul and destroy the torpedo boat and thus rid the big ships of a possible enemy. Since the torpedo boat destroyer, in addition to rapid fire rifles, itself carried torpedoes, since it was, if anything, even faster and more seaworthy than the torpedo boat, it was obvious that the torpedo boat could be dispensed with, and so torpedo boats, in the old sense of the term, are no longer built. But even the torpedo boat destroyer never brought out the full possibilities of the torpedo. It was the submarine that really opened up the field for torpedo attack, simply because of its ability to make its way within easy range without exposing itself to gun-fire.

The capital ships of the world's navies are equipped for firing torpedoes as well as torpedo boat destroyers. But so deadly are the guns of a battleship at great distances that actions are now fought far beyond effective torpedo range. Hence the development of naval architecture has brought with it a development of the torpedo—a development which has had for its object an increase of speed and range.

The tactical possibilities of the submarine have led to the development of a torpedo especially adapted for submarine use—a short range weapon carrying a charge of explosive 30 to 50 per cent heavier than that which fills the warhead of the standard torpedo. This end has been attained by employing weight and space previously given up to the propelling medium not needed when operating at such short ranges as 300 or 600 yards at which a submarine strikes.

The torpedo is by far the most expensive and complicated piece of mechanism used in naval warfare. Its design and construction have taxed the ingenuity of the most ingenious minds. Consider what is demanded of this formidable weapon: It must travel at railroad speed beneath the water; therefore, it must have a powerful engine plant. It must never swerve from a predetermined course; therefore, it must have a mechanism to keep it from plunging too far beneath the surface, and from departing too far from a vertical plane. It must carry an explosive charge of sufficient power and size to inflict serious injury; therefore, it must have a large explosive-carrying capacity. It is a little high-powered ship, carrying destruction in its warhead—a little ship which runs itself and guides itself, as if it had a human engine crew and a human pilot.

The earliest torpedo was merely a tapered wooden spar, capped with an explosive head and capable of being projected over short distances. It soon gave way to a shell containing a propelling system. But in spite of its increased speed, in spite of its superiority to the tapered wooden spar, this form of torpedo was far too erratic, even though brought to a comparatively high state of mechanical perfection. It could be employed with safety only under ideal conditions, and then only



The discharge of a torpedo

for a range of about 500 yards. It was a submarine projectile, depending for accuracy upon delicate adjustments, determined by trial; and even with these adjustments, the weapon could not be relied upon to follow a straight course, since it would be disturbed by many external influences as well as by its own rolling.

It was the introduction of the gyroscope that gave us the modern automobile torpedo; for by means of the gyroscope it was possible to cause the steering gear to bring the swerving torpedo back to its course. Not only that, but the effective range was more than doubled.

This early torpedo was driven by compressed air. Its essential features are revealed in Fig. 1. The compressed air was stored at about 2,000 pounds per square inch in an air flask, Fig. 1, forming part of the torpedo body. From this flask the air was conveyed through a reducing valve, and thus supplied at a uniform working pressure of about 200 pounds per square inch to a small reciprocating engine.

In order to increase the range of the weapon, superheating of the air was resorted to. The old style of internal superheater is disclosed in Fig. 1. Within the air flask 1 was a copper superheater bowl 2, with a spider on top, carrying a funnel-shaped outlet 3. The main air supply pipe 4 was connected with this outlet 3, and was carried as far as the reducing valve 5, necessary to feed the air gradually at a predetermined pressure to a three-cylinder Brotherhood engine. The air was superheated by means of an alcohol flame. Fuel was drawn from a flask 7 and supplied by a feed pipe 8 to the superheater bowl 2. The alcohol was ignited by means of the tube 9, at the top of which was a cartridge. As the torpedo was launched and a latch pulled, the cartridge was detonated so that a flame was projected through the tube to the bowl 2, in order to ignite the fuel. Freezing had always been a serious drawback when cold compressed air was used. This superheating system eliminated that difficulty. The old gyro gear is shown at 10. It controlled the valves of a steering engine 11.

Contrast with this early type of weapon the improved mechanism shown in Fig. 2, and it becomes apparent how remarkable have been the strides in the development of the torpedo. When F. M. Leavitt introduced the balanced turbine and the external superheater, the efficiency of the torpedo was greatly increased. The range was gradually extended and the speed increased until it was possible to dispatch the weapon over its course of 5,000 yards at a velocity of nearly 36 knots. From the air flask 1 a pipe 2 leads to the reducing valve group 3, connected with the superheater flask 4. Fuel is conveyed to this superheater flask from the alcohol flask 5. Within the flask 4 is an ignition device, more or less similar to that which has been described in connection with Fig. 1. A pipe 6 leads from the lower end of the flask 4 to the nozzle 7, by means of which nozzle superheated compressed air is projected against the blades of a turbine 8, of which 9 is the rotor and 10 the stator. The turbine runs at about 10,000 revolutions per minute, and its shaft 11 at about 1,500. Hence, an intermediate reducing gear 12 and 13 is necessary. The turbine exhausts directly into the after body shell 14, through the funnel 15, through the hollow shaft 16, and thence through the tail of the torpedo. A spider 17 connects the funnel 15 and its attached hollow shaft

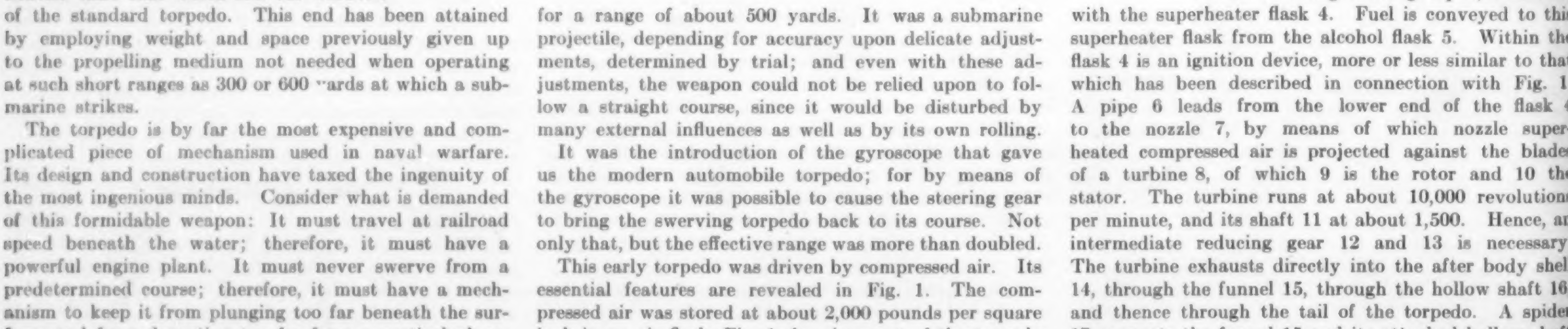


Fig. 2—Detail of superheater, balanced turbine and reducing gear

16 with the solid shaft 11. Within the funnel-shaped body 15 is a valve against which a spring presses lightly. It is the object of this valve to prevent the entrance of sea water, the adjustment of the spring being such that the exhaust gases may readily escape. The propellers 18 must be revolved in opposite directions. This is accomplished by the bevel reversing gearing 19.

The torpedo is steered in a horizontal course by the vertical rudders 20. These rudders are connected by a semi-circular ring 21, attached to the rudder rod 22, operated by the gyro-steering gear 23.

In order to prevent the torpedo from diving or from rising, an automatic depth gear is installed. As shown in Fig. 3, the depth gear rudders 26 (one at each side), are connected with a rudder rod 24, leading to a servo motor 27. A pipe 28 supplies this servo motor with air at about 400 pounds per square inch pressure. Within this servo motor is a balanced piston valve 29, which can be operated with very feeble power. Exposed to the sea is a hydrostatic diaphragm 30, connected with which is a threaded stem 31, upon which is located a nut 32. Against this nut one end of a spring 33 passes, the other end of the spring being seated in the top of the diaphragm chamber 34. The stem 31 extends through the diaphragm, and terminates in a square head 35, packed so that water may not leak into the chamber 34. In order to turn the stem and move the nut 32 up or down a key is used which is applied to the square head 35. Thus the spring pressure on the diaphragm 30 can be increased or decreased. The compression of the spring may be regulated by means of an index carried on the square head 35 so that the spring may be adjusted to the depth at which the torpedo is to travel. The diaphragm 30 also carries a trunnion bearing 36, which engages a lever 37, keyed to a shaft 38, which runs through a stuffing box, to prevent the entrance of sea water. Within the torpedo is a lever 39. Movement of the diaphragm 30 sets up a corresponding movement of the lever 39. Fulcrumed at 40 is a lever 41, the upper end of which is connected by a rod with the piston valve 29, and at its lower end with the rod 43, leading to the pendulum 44. The connection with the pendulum is not rigid, but yielding as shown. The rod 43 passes through an eye 45 on the pendulum rod. Around the end of the rod 43 two springs 45 are coiled in opposite directions and are held between the adjustable nuts 46. This arrangement is such that the pendulum does not immediately transmit motion to the rod 43, but stores up energy in the springs until the pendulum has moved through a distance of about three degrees. At this point the stored energy in the spring is sufficient to move the rod. The pendulum is suspended from a bracket 47, attached to some convenient part of the torpedo.

Assuming that the stem 31 has been properly adjusted and assuming that the torpedo has been launched, what is the operation when the depth rudders swing from their correct position? The pressure of the sea water against the diaphragm 30 and the pressure of the spring 33 counter-balance each other. If this counterbalance is disturbed, the rudder 26 must inevitably be operated. In Fig. 3 the rudder 26 is in the down steering position. As the torpedo proceeds in its downward course, the pressure of the water overcomes the spring 33 with the result that the piston valve 29 is pushed in and the rudder 26 is moved upward.

The pendulum 44 is employed to modify the diving effect which would take place if only the hydrostatic diaphragm were depended upon. The effective strokes of the hydrostatic diaphragm and pendulum are so proportioned that one tends to neutralize the other. If, in passing from above to below a set depth, the torpedo dives at an angle of more than, let us say, three degrees, the pendulum swings over and gives the rudder a slight upward tilt, or the reverse as the case may require. Hence the torpedo travels in a somewhat sinuous, though on the whole, substantially straight course, at a mean distance below the surface, closely approximating the set depth. The operation of this combined apparatus is fairly satisfactory, especially with respect to the hydrostat. The pendulum, on the other hand, is open to certain criticism. For example, it is heavy and it has a tendency to lag as the speed is accelerated.

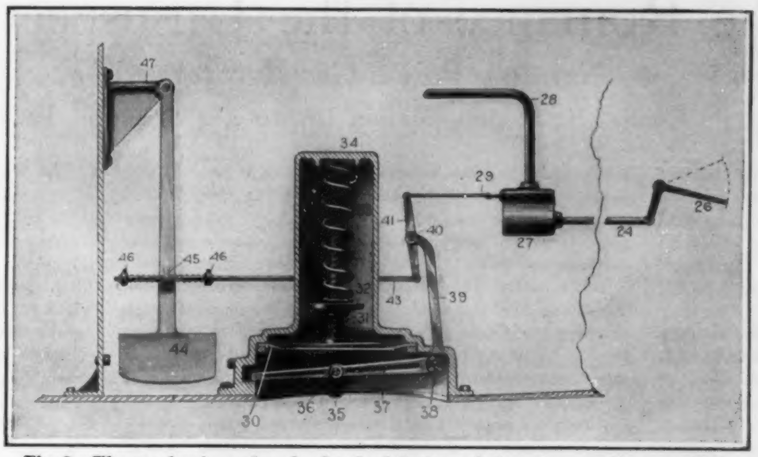


Fig. 3—The mechanism whereby depth of the torpedo is automatically controlled

As the basis of a clear understanding of the automobile gyroscopic steering gear employed in the torpedo to prevent the weapon from swerving to either side of its given course, we must regard the gyroscope as the compass of the torpedo as well as its pilot. Assuming that we desire to proceed due north, and knowing that the compass needle, to use the popular expression, "points toward the north," it is clearly necessary while navigating the vessel to make sure that the compass itself does not deviate—in other words, that we do not run off the course. The compass is our guide, and by manipulating the helm we are enabled to steer the vessel over virtually a straight course. The gyroscope is in essence a rapidly rotating flywheel. It is a property of such a body to resist all efforts to change its plane of rotation.

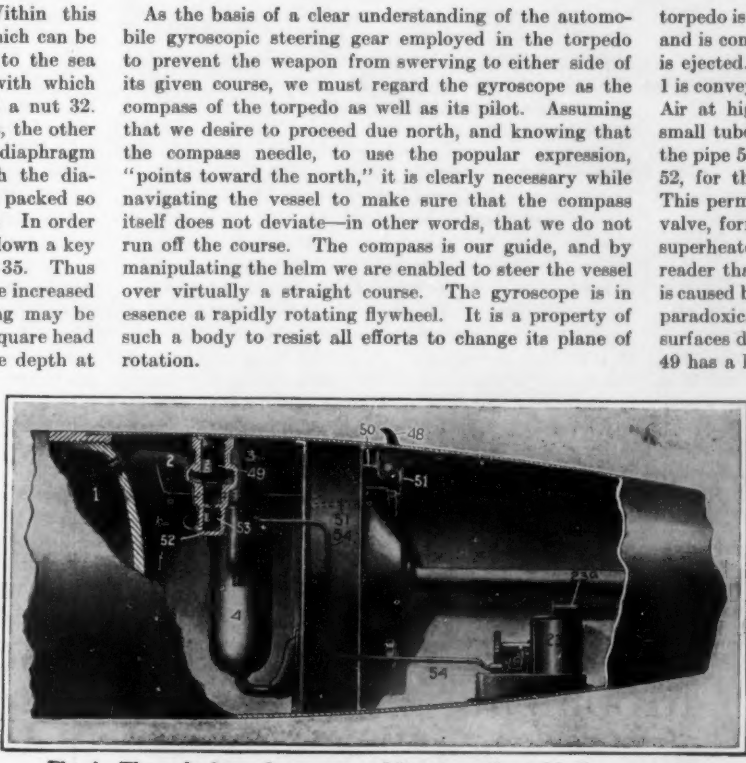


Fig. 4—The reducing valve group and its connection with the gyroscope

The gyroscope consists of a small heavy flywheel mounted so as to be freely revolve in a frame which is in turn pivoted in a gimbal ring. The wheel, thus mounted, is free to swing around, both in a horizontal and a vertical plane. A locking device is provided which holds the flywheel carrying the frame, and consequently the wheel itself in a fore and aft position in the torpedo during the operation of spinning the gyroscope. While thus held, the wheel is revolved at high speed. When released it will retain its plane of rotation, and even though the torpedo may be swung around horizontally, the gyroscope will remain substantially in a fixed plane so long as it continues spinning at a sufficiently high velocity.

Except that the gyroscope does not necessarily take up a north-and-south position, but retains any position impressed upon it, it acts as the compass of the torpedo. The torpedo with the gyroscope locked in a fixed relation to the axis of the weapon, is placed in the launching tube. When the launching tube has been pointed toward the enemy and discharged, the gyroscope, which has been simultaneously spun and unlocked, retains the original direction of rotation impressed upon it at the moment the weapon is released. When the torpedo is on its way the gyroscope serves the double purpose of compass and steersman. Automatically it operates the helm to steer the vessel over a substantially straight course.

In Fig. 4, the starting latch and gyroscope spinning mechanism of a standard type of torpedo are illustrated. The figure is a detail of the torpedo shown in Fig. 2, 1 indicating against the air flask and 4 the superheater, and 3 the reducing valve group. The starting latch 48 on the torpedo is engaged by a pawl, located in the torpedo tube, and is consequently pulled or shifted over as the torpedo is ejected. As a result high-pressure air from the flask 1 is conveyed by means of the pipe 2 to the stop-valve 49. Air at high pressure simultaneously flows through the small tube 50. When the latch 48 is thrown, the air in the pipe 50 may pass through the pipe 51 to the chamber 52, for the purpose of pushing up the stop valve 49. This permits the air to flow freely through the reducing valve, forming part of the valve group, and through the superheater as previously described. It will strike the reader that air pressure from the same source of supply is caused both to open a valve and to hold it closed. This paradoxical feat is accomplished by giving the valve surfaces different diameters. It will be noted that valve 49 has a larger surface than valve 53.

From what has been said it is evident that high-pressure air enters one side of the valve group and issues from the other side at a reduced pressure. From this reduced pressure side runs a pipe 54, by means of which air is supplied to the gyroscopic spinning turbine 23 at the proper time. This air is also conveyed to the cylinder of the servo motor 23a located on top of the gyroscope 23. In the early short range torpedoes the gyroscope was spun by means of a spring which rotated the wheel at high speed by a sudden impulse. The spinning mechanism passed out of contact with the flywheel shaft after the operation and left it unhampered and free to rotate by virtue of the energy stored in the rim of the wheel. With the increase in range and the necessity for storing a greater amount of energy in the flywheel in practically the same short space of time, it became apparent that a more powerful impulse was necessary. As a consequence compressed air was made to impinge upon a small turbine wheel in the manner shown in Fig. 4. By this device the efficiency of the gyroscope was greatly increased. It was held by some that the utilization of air from the main charge for the purpose of spinning the wheel was undesirable, but the amount of air used is so small that the range of the torpedo is not seriously affected. The only improvements made recently to keep the gyroscope spinning as long as possible have been mechanical refinements rather than important inventions. A little more energy has been made available by the introduction of ball-bearings in the flywheel journals and at the gimbal pivots, thus reducing friction.

After the gyroscope has been spun it must be released from the starting turbine. This release, however, must be affected without jar and without in any way retarding the gyroscope. For that purpose a releasing mechanism has been devised which is so delicate that it accomplishes its purpose within the period of a sixth of a second—the launching interval of the torpedo.

In Fig. 5 the mechanism for releasing the gyroscope after it is spun is illustrated. The flywheel 55 of the gyroscope revolves in anti-friction bearings, carried by a gimbal ring, which is also pivoted at 58 in the ring 59. The gimbal ring 59 is supported in pivots 60 located on a vertical center line. The entire gyroscopic flywheel is inclosed in an outer casing 62, so that the gyroscope and its sub-casing 61 (virtually a frame), may be removed in its entirety from the outer casing 62. The vertical bearings 60 are located in the sub-casing or frame 61, at the bottom of which is secured a plate 63 provided with two openings 64, through which the fingers

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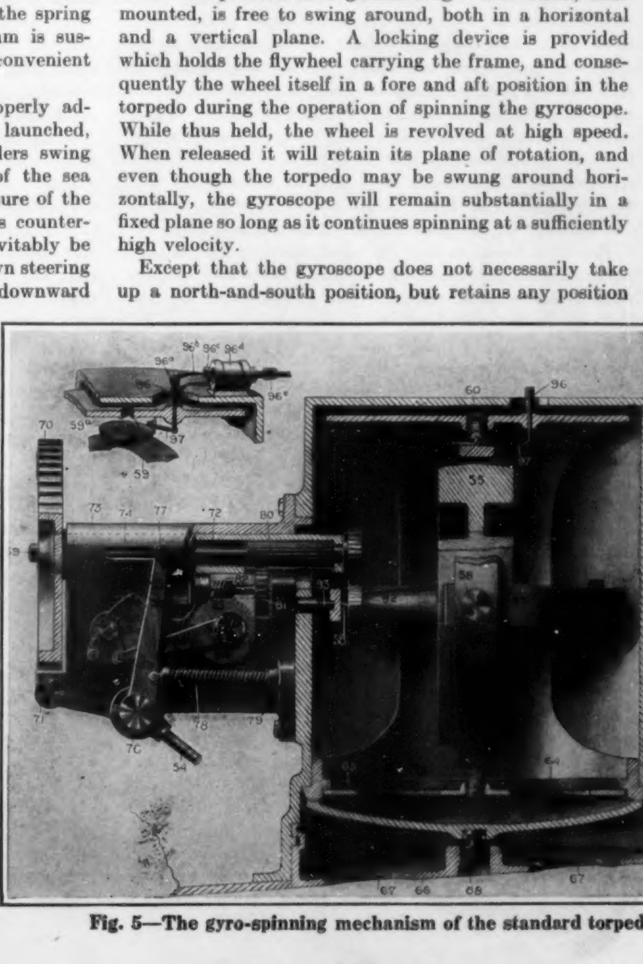

Fig. 5—The gyro-spinning mechanism of the standard torpedo

The Romance of the Unsuspected

Nature's Poison-Gas Retorts

By Charles S. Palmer, Mellon Institute, Pittsburgh, Pa.

THIS is a story about one of the queer things that are continually happening in the limitless field of chemical discovery; for, if the dear public only knew it, there is more of the novel and sensational in the good Journals of the American Chemical Society, than there is in the last war bulletin or the last "thriller" of the best-selling novel.

This story has to do with what the chemist calls "carbon-monoxide," for short. This carbon-monoxide is a very common substance, and a weird chemical paradox. It is a colorless gas, without any decided taste or odor, but with an inherent antipathy toward human life; that is one side of its character. The other side is that it is probably a common go-between in that wonderful alchemy, whereby the green chlorophyl umbrella of green leaves, and the sunlight, play their continual duet of reducing the carbonic acid of the air, to the sugar-like substances on which animal life of the globe depends. And that is quite enough of a proposition for one small substance to tackle.

Now, in a way, we are familiar with this witch, carbon-monoxide. It is the stuff which burns with that beautiful blue-green, or green-blue flame in the bottom of the humble candle flame. It is the same stuff which shows the almost colorless flame when fresh coal is added to a fire. It shows well in the common gas range, with the same blue-green flame.

We are also very familiar with the same gas, when it furnishes our papers with the laconic note that Mr. So-and-so committed suicide by "turning on the gas" and forgetting to turn it off. For this carbon-monoxide is a large part of common city gas, especially when it is what is called "water-gas"; and this water-gas would work deadly havoc with civilized humanity were it not for the fact that, to get common gas to give light as well as heat, it is customary to "carburet" the gas with some cheap oil; and as this cheap carburetting gas is itself bad smelling, and gives common city gas most of its bad odor, it also serves to warn careless humanity when "the gas is leaking." And so it comes about that water-gas, though very poisonous, on account of the large quantity of this same carbon-monoxide gas, actually poisons very few people, because the dangerous leak is so well and promptly advertised by the bad smelling carburetting gas. Thus we are, albeit unconsciously, very closely associated with the heroine of this story, the tantalizing carbon-monoxide.

But now the strange part of this narrative comes in. If this carbon-monoxide gas is so common in such common processes as the burning of coal on the one hand, and in the reduction of carbonic acid gas on the other hand, why does it not accumulate in some corner of Mother Nature's laboratory? Why should we not find it in convenient hiding in a thousand places? Why should we not run across it every now and then—not in the animal world, for it is really poisonous to most animals, perhaps to all—why should we not find it at least quite common in some nook of the vegetable world? For the fact is, and we have told it by our series of queries—the fact is that this carbon-monoxide gas has not been commonly found in the vegetable world. And that is all the more strange, because the air food of most green plants must go through a stage where it is something very much like carbon-monoxide. Perhaps the real reason is that we do not yet know that this witch, carbon-monoxide, is not very common in plants, green plants particularly. And back of that statement is another which one might make with a large degree of safety. Perhaps it is not known to be common because it has not been looked for. For it is a curious fact in chemical progress, that there are lots of things which are not found till they *are* looked for, in the hide-and-seek of inventive carelessness. A similar thing was true of the finding of argon and its attendant throng of inactive elements in common air. Though the first facts which, if followed up might have told our great-great grandfathers, were known, yet they were not followed up, till another set of facts forced the issue—and so argon and her attendants came out into the open. A somewhat similar thing was true of that sensational element, radium; though, when it was once well guessed at, it still took many months of fractioning out to get even a microscopic sample of the most revolutionary element of all—radium. But this is not the story of radium.

The finding out of one hiding place of carbon-monoxide came about in a curious way. We do not need to be told that one result of the war has been a marked scarcity of potash compounds in all countries, except Germany, which has vast stores of potash in connection with her salt mines. Now, it was a side hunt for potash which brought out the knowledge of one lurking place of carbon-monoxide. Among the many places where our chemists looked for potash compounds, was in the ashes of sea-weeds; and it was in one of these floating vegetable unused wastes that a most interesting discovery was made. It came about in this way:

In getting out a report on the possibility of the economic extraction of potash salts from sea-weeds, a careful survey was made of the chemical composition of all parts of the large "kelp" sea-weeds of the California coast. And, further, in this chemical survey, it was noticed that some of the kelp plants contained large quantities of a mixed gas. Now in the analysis of this gas from one kind of gigantic kelp on the California, or rather, on the Washington coast—a brown alga, which modestly tolerates the name *Nereocystis luetkeana*, this carbon-monoxide was found. This kind of kelp is said to grow with stipe, or stem, or stalk of from fifty to eighty feet in length. These stalks are hollow, from the bulb-like top, to the "hold-fast" at the bottom. "The walls of the stipe are from a quarter to three-quarters of an inch in thickness, and are lined on the inside with a delicate web-like structure which is relatively quite dry. This hollow space, in large specimens, has a capacity of from three to four liters"—that is several quarts. "The gas is almost always under less than atmospheric pressure." There it is, the hiding place, or one of them, of this chemical dryad of the vegetable world—the air spaces of the stems of this giant seaweed of the Pacific coast.

Now this gas from this corky stem substances of this kelp had been analysed before; and oxygen, nitrogen and carbon-dioxide had been reported; but not carbon-monoxide—till one Seth C. Langdon of the State University of Washington at Seattle, noted something

(Concluded on page 562)

Mobilizing Our Medicine

By C. H. Claudy

WAR, guns, shells, injuries, death—doctors, nurses, operations, ambulances, Red Cross! Thus runs the thought of the man in the street, if he gives any attention at all to the part the medical profession plays in the greatest of all games.

Vitally important though the field service of surgeons and their staffs unquestionably is, it is by no means the major part of the duties of the medical profession as far as either Army or Navy is concerned. This has been very thoroughly demonstrated abroad during the past three years. That the United States has taken the lessons of the European war to heart well in advance of its own entry into the struggle, is a matter which is daily becoming one of greater congratulation. There can be no continuously effective field service without an adequate medical preparedness—and this is what we are now securing.

One year ago the National Committee of American Physicians for Medical Preparedness was appointed by the joint action of the presidents of the American Medical Association, the American Surgical Association, the Congress of American Physicians and Surgeons of North America, and the American College of Surgeons, charged with the responsibility of formulating plans by which the civilian medical resources of the nation might be ascertained and effectually coördinated for any service the Federal Government might require.

When the Council of National Defense and its Advisory Commission was formed, it took over the direction of the work of this national committee of physicians and surgeons, at the suggestion of Dr. Franklin H. Martin of the Council of National Defense, who was made Chairman of the Committee on Sanitation and Medicine. Having an organization ready to its hand, with much preliminary work accomplished, the Council of National Defense is able to show, perhaps, an even greater progress in the work of making available the medical resources of the nation, both material and personal, than in any of the other departments of its extensive program of industrial preparedness. Dr. Martin asked the Advisory Commission and Council to make Dr. Frank F. Simpson Chief of the Medical Section of the Council, that he might bring his experience as executive officer of the Committee of American Physicians to bear on the many problems of this work.

First among the many vital problems presented for solution was that of ascertaining the available well-qualified physicians and surgeons—how many there were, what they could do, should do, would do, if necessary. In few words and short, the accomplishment of this task has resulted in the selection of 21,000 competent physicians (using the word in its inclusive sense). These men have been classified according to their special training and recommended for the Officers' Reserve Corps. Application blanks have been sent to all of them, and the response has been most gratifying; nevertheless "recruiting" of competent medical men is still going on.

But it is being carried on very carefully and with a magnificent organization of National, State and County committees worked out and put in operation by Dr. William J. Mayo and Dr. F. F. Simpson, to whose untiring efforts, as Chairman and Secretary of the Council of American Physicians, the Medical Section of the Council of National Defense, largely owes its present accumulated fund of accurate information.

For the men selected must be able men—not any old doctor who can show a certificate of graduation! And he must be in such a position in life and society that calling him to the colors will not be pulling a brick from a structure which cannot afford to lose a single stone. England made and rued the fatal mistake of encouraging medical students, instructors in medical schools, all physicians in active practice, internes, specialists—every one with any medical knowledge, to enlist and go to the front. "On to France—our wounded need you" was their cry. And they responded—Oh, yes, they responded in such numbers and with such enthusiasms that when shells, disease, accidents—when war, in other words, had taken its toll, England was very near a famine in medical men and had so crippled her institutions that she could not, quickly, graduate new men to take the place of those who had made the supreme sacrifice.

Nothing like that is to be allowed to happen in this country. If we need ten thousand physicians and surgeons for field service, and if the year after we need another ten thousand, we are going to be able to supply them. To cripple civilian hospitals, and ruin medical schools to fill the immediate need, is a mistake the Government will not make. Hence, while still sending out application blanks, and encouraging, with every possible patriotic inducement, high grade men to ask for Officer's Reserve Corps Commissions, the Government proposes to accept only those who can best be spared, and who are, at the same time, of the type to make good Army or Navy doctors.

Field service—meaning surgical work behind the battle line—is only a part of the physicians' work in time of war. Knowing this, the Council of National Defense is working out the problems, as they have been presented to, and solved by, the Allies in Europe, with all the speed and skill at their command. For instance, it is essential that the military medical officer be held responsible for the physical characteristics of health of recruits. Signing up a sickly, diseased or imperfect physical specimen for military service is a hurt, not a help, to an army or navy. The military medical man must understand the importance of sanitation; he must be able to guard the health of troops in the field, to provide for the physical welfare of men leaving the Army or Navy after the close of war, to guard the civilian population with which large bodies of troops come into contact from any dangers which might be communicated from them to the soldiers; he must know how to protect both civil and military population from pollution of water supply, how to prevent water supply from being polluted; he must understand the hygiene of refugee and prisoner camps, where fright, ignorance, dirt, and a complete upset of all ordinary standards of living make fertile ground for the spread of disease—indeed, to catalog all the duties which the medical forces will have to perform would be wearisome.

The Council of National Defense is attacking, through its many sections, so many problems of national defense at the same time, that no one can very well be singled out as the most vital or most important. But perhaps none are of greater importance, in the medical section, certainly, than the standardization of medical supplies, and the organizing of manufacturers for a medical preparedness.

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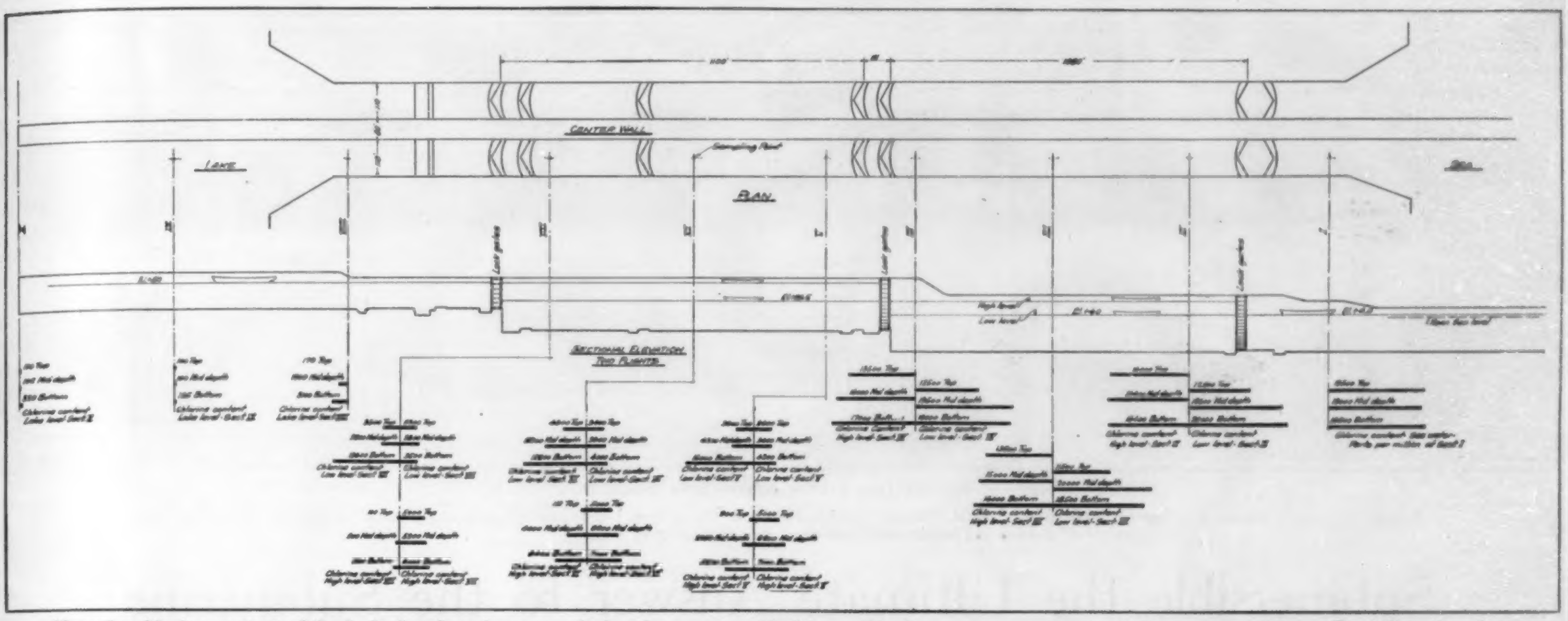

How the chlorine content of the lock chambers increases during the process of lockage. The figures represent parts of chlorine per million. For full explanation of the various readings see the text

How Salt Water Climbs the Miraflores Locks

By George M. Wells and R. H. Whitehead
Formerly of the Canal Engineering Staff

AT the time the barrier known as the Gamboa dike was blown up and removed, thus permitting the waters of the Gatun Lake to enter Gaillard cut and marking the beginning of the completion of the canal, certain press accounts gave a description of the event that caused "The Waters of the Atlantic Ocean to mingle with those of the Pacific."

That part of the canal lying between Gatun on the north and Miraflores on the south is what might be termed a fresh water bridge. The major part lying between Gatun and Pedro Miguel is at an elevation above sea level of approximately eighty-five feet. This is known as the Gatun Lake and Gaillard cut section. The minor part lying between Pedro Miguel and Miraflores is known as the Miraflores Lake section and is at a maximum elevation above sea level of approximately fifty-five feet. The remainder of the canal extending from deep water in the Atlantic and Pacific to Gatun and Miraflores may be called the approaches to the bridge. The locks at the inner ends of these approaches may be thought of as flights of stairs, by means of which access is had to the bridge from the approaches.

At first thought it would be said that the waters of the Atlantic and Pacific, being heavier than fresh water, could not climb the stair flight and mingle with the fresh water of the lakes, but as a matter of fact such is the case, and it is the purpose of this article to describe this phenomena and its effect.

Miraflores Lake has an area of approximately 918 acres and a mean maximum depth over a large portion of the central section of 45 feet. This depth is dependent upon the operation of the controlling gates at the spillway, and under certain conditions the depth may decrease to 40 feet, giving a surface elevation above mean sea level of 50 feet.

It was originally intended to use this body of water as a source of domestic and industrial water supply for the cities and villages located on the Pacific slope of the canal. Within a short time, however, after the passage of vessels through the canal commenced, it was discovered that the chlorine content of the lake water was rapidly increasing; in other words sea water was entering the lake simultaneously with shipping and the water was becoming noticeably salty. The source of domestic water supply was therefore changed to a point on the Chagres River near Gamboa.

On April 3d, 1914, tests were made at the Miraflores Locks to determine the chlorine content of the water in the lock chambers during the successive stages of raising a vessel from tide level to lake level. The results are indicated diagrammatically in the figure above.

(Concluded on page 562)

The Mechanics of Marching

A Few Points for the Weary Foot-Soldier

By A. L. Hodges

THERE are two things, and two things only, which determine the length of a day's march for a soldier. The first is the amount of actual labor or mechanical work done while marching, the second is the degree of even distribution of this labor among the chief muscles used in performing labor. Now labor, or work, is simply the product of the force overcome and the distance through which it is overcome. The forces to be overcome are by no means confined to the weight of the man and his pack. Many other forces are called into play in the course of a day's march.

To illustrate, suppose the marcher has to carry a five-pound weight on the end of a five-foot stick. Suppose he places this stick across his shoulder with 4 feet behind him and 1 foot in front. By the simple exercise of bad judgment, he multiplies the weight of his load by four; he has to pull down continually with a force of 20 pounds, and the shoulder must continually push up with a force of 25 pounds, all on account of that five-pound load which is carried on the end of the stick.

Another way in which energy may be wasted is somewhat more subtle, and perhaps a bit harder to understand, but of equal or greater importance. It lies in the principle that work has to be done whenever a mass of any kind is changed in its motion. It takes more energy to start a street car, for instance, than to run it at uniform speed. It takes more energy to make its speed a little faster than to maintain it at the fast speed. That is, whenever a body is given an acceleration a new force has to be used. Now, every time a soldier bobs up and down when walking, he has to start the weight of his body and pack and gun upward and let them down again. To do this uses up more energy than simply to keep them moving up or down. In the one case only the pull of gravity has to be overcome, in the other the inertia of the soldier's head and body. And the faster this is done the more energy is used up, *per step*. Hence it is that a slow walk can be maintained, not merely for a longer time than a fast one, but for a longer *distance* on a stretch.

Making a load light or heavy at will. The man at the right is doing four times as much work as the other

Using up energy on loosely hung equipment

A loosely fastened pack with the weight at the top is a bigger strain than a snug pack with the weight lower

How we use up work in raising and lowering the body's weight when we walk

The Indian's solution—crooking the knee as the body swings past

Under the principle outlined above would come the loss of energy due to all swinging articles, such as bayonet scabbards, tin cups, tassels, etc. These have to be put in motion, then jerked back and stopped by bodily contact, then put in motion again. All this consumes energy, and work has to be done.

Again, any weight on the breast of a soldier, or a tight coat or shirt, has to be overcome every time he breathes. And the deeper his chest expansion the more work he has to do with his breast every time he takes a breath. This amounts to an enormous total during a day's march. A loose coat and underclothes will cause him to travel with a less expenditure of energy. It must be remembered that this is actual energy used up, taken from the store of energy available to march with.

Besides the up-and-down motion of a soldier while marching, he sways from side to side. Every article he is carrying, and his own body, is thus started and stopped in this swaying direction also. Thus energy is used up. Now, the upper part of his body sways farther than does the lower part, so if pack there must be, the heavier part of it should be placed just as low down the trunk as is convenient or comfortable. The heavier articles should also go as close to the back as possible so as not to increase the leverage on the straps holding the pack to the body.

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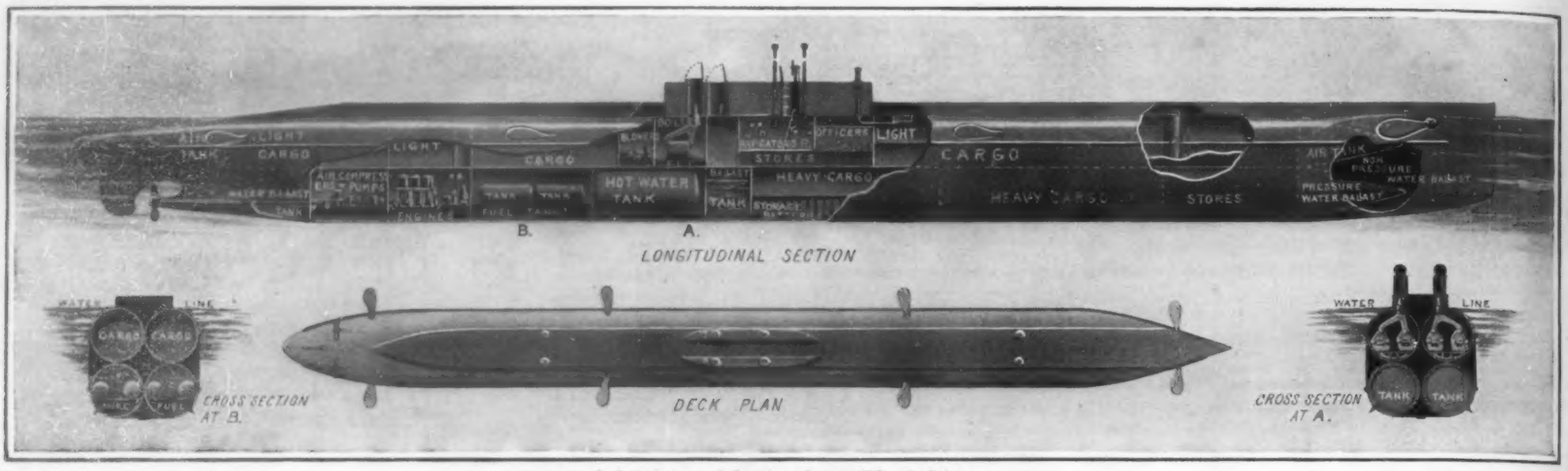


A 5,000-ton, 8-knot submersible freighter

Length, 410 feet. *Deadweight Capacity*, 5,000 tons. *Speed*, 8 knots. *Motive Power:* at the surface, boilers and reciprocating engines; submerged, hot water tanks and reciprocating engines. *Speed*, submerged, 5 knots.

Submersible the Ultimate Answer to the Submarine

Some Particulars of a 5,000-Ton, 8-Knot Freighter for Transatlantic Service

THE two successful voyages of the "Deutschland" between Germany and the United States proved to a demonstration that freight can be carried successfully for great distances by submersible merchant ships; and in sending that ship across, Germany proved to the world that if the pressure of their U-boat attack became sufficiently great to make it necessary, a fleet of submersible freighters could be built and operated successfully on the Atlantic Ocean.

The "Deutschland," moreover, was sufficiently large (she could carry one thousand tons of dead weight) to prove that it would be feasible to build vessels of this type of 5,000, or even 10,000 tons, dead weight capacity; for the increase in size would not introduce any new and untried principles that might prevent the successful operation or endanger the safety of the larger ship.

Although the "Deutschland" was the first submersible freighter to be constructed, it will be within the memory of the readers of our journal that long before she made her appearance, we published in the SCIENTIFIC AMERICAN the plans for a large ship of this type by Mr. Simon Lake, whose contribution to the development of the submarine has won for him a well-earned reputation.

The present article is devoted to the illustration and description of a 5,000-ton submersible cargo ship, which has been designed to meet the present submarine crisis and neutralize the peril of German U-boat piracy. In view of the urgency of the situation, any acceptable design must meet the following conditions:

1. Simple construction.
2. Standardized construction calling for the use of material that may be rolled, bent and punched at the mills and quickly erected on the buildings ways.
3. A type of construction that will admit of the use of comparatively unskilled labor, controlled by a few skilled foremen.
4. A ship of low speed, permitting the use of small and compact motive power.
5. Use of a type of motive power that is simple, well tried, and that calls for no special knowledge and skill for its operation.
6. The adoption of a type of motive power which can be used both at the surface and under-sea.

The design here presented has been brought to our attention by its author, Mr. Charles Bright, M.I.E.E., of this city and London, and is presented as being a very practical study of the problem and fulfilling the conditions above laid down.

The plans provide a standardized ship of large cargo-carrying capacity (5,000 and 10,000 tons), strong and safe, and able to navigate on the surface or under-sea. It is of simple construction, so designed as to permit of the use of standard steel shapes and plates of full size, and entailing a minimum amount of labor and waste material. Over 80 per cent of the principal hull consists of only one type of plate and one shape. The plates can be multiple-punched; they require no furnacing, but are simply cold-rolled through bending rolls to one fixed uniform curve. Little labor, skilled in shipbuilding, is required, as ordinary steel workers, riveters or laborers can be quickly trained. A large number of men or gangs can be employed at one time on the vessel without one gang interfering with another. The 5,000-ton ship can be constructed in less than ninety days, when the work is well under way, with Government backing, Mr. Bright believes that when the gangs are well trained construction can be completed in less than sixty days.

If the ships are intended only to transport cargoes to England and France, and no surface craft but only U-boats have to be avoided, a very simple, quickly and easily constructed power plant can be employed, instead of the usual Diesel engines and storage batteries. A steam plant for surface and sub-surface propulsion can be utilized, introducing only old and well-tried methods.

The outer lines of the ship resemble those of the ordinary ship, but the vessel is made up of a composite hull, formed of a number of heavy pressure-bearing tubular sections, extending the length of the ship and worked in with the lighter sections and transverse bulkheads, in a manner to give added strength to the structure as a whole. The steel frame shell and bulkheads required to withstand the collapsing pressures are utilized to the full in obtaining the necessary longitudinal strength, so that the material required is reduced to a minimum.

Mr. Reuterdahl at work on a Navy poster

Nevertheless, the vessel produced offers the following special advantages: standardization, simplicity, and economy in time, labor and material never attained before in ship construction.

Two longitudinal water-tight bulkheads, one horizontal forming a deck and one vertical to make a self-trimming grain or cargo carrier, free from danger of shifting cargo, are all-important points in submersibles, where both surface and sub-surface stability must be maintained. The ship is an ideal bulk oil-carrier. The numerous transverse bulkheads are of the simple dished pattern, obtainable direct from the mills, and offering the greatest strength, simplicity and minimum of labor and space required. The vessels, even with a sufficient store of fuel for a 12,000-mile voyage, will have a large cargo capacity.

The power plant and heavy cargo are carried in the lower holds, and lighter cargo and living and navigating space is provided in the upper holds. An important feature is a fifth central alleyway, extending from bow to stern within water-bulkheaded walls that gives access at all times to all compartments or holds, and provides a pipe gallery for all pipes and gear used in operating the ship. Thus all pipes, valves, steering gear, etc., are always accessible for inspection and ready repairs.

The ship has ordinarily a surface speed of over 8 knots, with a 12,000-knot radius of action and a submerged speed of 5 knots with 90-knot radius, with the simple

(*Concluded on page 562*)

How the American Artists Are Helping Their Navy

By Henry Reuterdahl

Associate, United States Naval Institute

ARTISTS are supposedly dreamers and stand on the side lines long-haired and in big neckties. But that is only in story books, for in this war the American painter and illustrator is hard at work helping the Navy in making publicity for recruiting. The Navy has a publicity office right in New York. It is commanded by Commander K. M. Bennett, U. S. Navy. Commander Bennett, as captain of the gunboat, "Castine," brought his ship out of the great hurricane at San Domingo where the "Memphis" was lost, a feat equal to escape of the H. M. S. "Calliope" at Samoa.

Just about when the war clouds were on the horizon, the writer called on Admiral Palmer, Chief of the Bureau of Navigation, and asked him what a paint slinger might do to help the Navy. The Admiral said, "Publicity," and when the war broke out, I laid my plans before Commander Bennett in charge of the Publicity Office. I said, "Captain, I have a scheme whereby I think I can enlist every American mural painter and illustrator to help the Navy, and do it for nothing. We will get the mural painters to design and paint billboards, and the illustrators to make posters, and it will not cost the Government a penny."

Commander Bennett looked up with an eye full of doubt and a smile which indicated "poor fellow, he is crazy with the heat." But because the Captain was a man of vision and imagination and knew the value of these artists, he opened the throttle wide, and our painters and illustrators are now working hard to help the Navy get men.

E. H. Blashfield, the dean of American mural decorators, has made a design representing Columbia calling upon the young men of the nation to enlist in the Navy. This design has been enlarged on the billboard and finished by Mr. Blashfield himself. The value of Mr. Blashfield's art measured by dollars runs into thousands. Similarly William deLeftwich Dodge, the man who did those wonderful decorations at the Panama Fair, is painting a big billboard for the Navy; and in his studio, Frank Dumond is doing the same. George Breck, who decorated the American Church in Rome, has temporarily left his murals and is designing the emblems of patriotism which are to adorn a billboard in New York City. And Milton Bancroft, another man who worked on the San Francisco Fair, is swinging his brush. He said, "A lot of us artists might not be very good on the firing line, and the least we can do is to put our talents at the disposal of the Navy and Army."

In Wilmington, Wyeth, painter and illustrator, has done a big billboard. J. J. A. Murphy, just back from

(*Concluded on page 566*)

Light-Weight Trench Mortars for A Moving Army

THE remarkable British army now fighting in France has ostensibly been organized for one purpose: constantly to move forward, driving the enemy ahead or capturing him or destroying him, until it has accomplished the desired results and brought this war to a successful conclusion. Of this there can be no doubt. The British trenches time and again have been described as extemporized constructions, in marked contrast to the elaborate concreted defenses of the Germans; but on the other hand everything in the way of offensive weapons is to be found in profusion with the British Expeditionary Force. Portable machine guns, movable cannon, and other weapons of like nature indicate better than words that the British army is not in France to remain in its trenches, on the defensive, but to drive ahead in a most determined and irresistible fashion.

Most trench mortars heretofore have been of heavy construction, equipped with large bases and intended for more or less permanent occupancy of a given place. As a sort of counterpart to the light-weight Lewis machine gun, however, the British army has adopted a light-weight trench mortar known as the Stokes gun after its inventor, Wilfred Stokes, which, too, can be carried forward by the charging infantry troops. This mortar, which is illustrated in the accompanying views, consists of a thin-walled barrel equipped with light-weight but rigid supports which can be adjusted so as to give the barrel the desired elevation and direction.

The weight of the Stokes mortar is such that it can be carried conveniently by one man; thus, the mortar is available for advancing infantry and can be erected and operated in an improvised trench or shell hole. The most deadly collection of diversified ammunition is now made for the Stokes gun, so that it is proving an invaluable adjunct to the other offensive weapons of the forward-moving British troops in every clime

Copyrighted, Kadel & Herbert

Wilfred Stokes, the inventor of the new portable trench mortar

The Stokes mortar in position, ready to receive a bomb

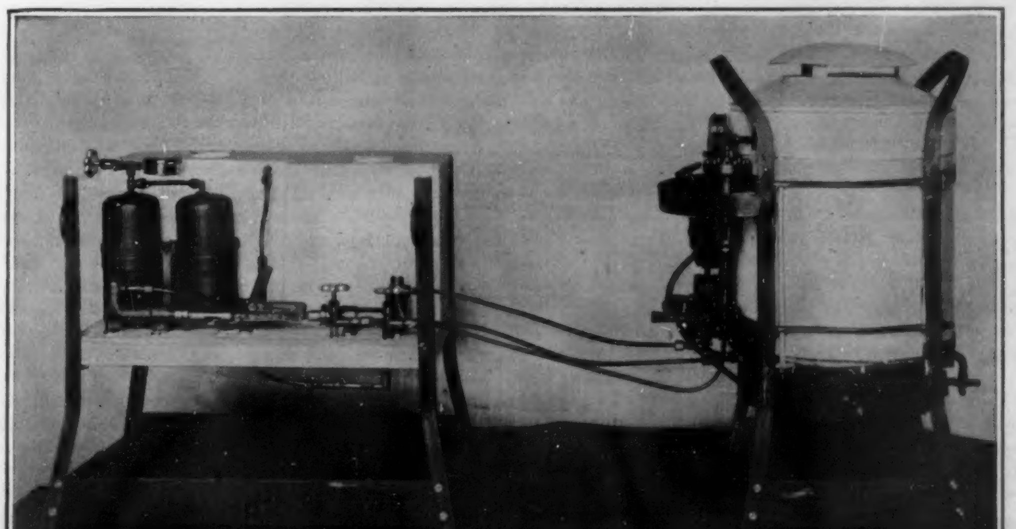
The portable Stokes trench mortar used by the British army

A Steam Pumping Plant for the British Trenches

ONE of the problems in trench warfare is to keep the trenches free of water, and many types of pumps are employed for this purpose, ranging from the simple hand-pump to the elaborate power-driven pump. Of considerable interest in this connection is a steam pumping outfit built in this country by a steam automobile manufacturer and sold to the British government for use in France.

The new steam pumping outfit, which is illustrated in the accompanying engraving, serves to pump water out of the British trenches in conjunction with a pulsometer steam pump. The power plant makes use of a standard steam-automobile 14-inch boiler, and is supplied with steam gage, safety valve, automatic fuel control valve, a steam pump for pumping water from the tank into the boiler, and a regular burner. The tank unit is supplied with a five-gallon tank and a three-gallon fuel tank, two fuel pressure tanks—the black cylindrical tanks shown in the illustration—and water and hand fuel pumps. For easy transportation in the trenches the pumping outfit is provided with metal loops on the standards, through which carrying bars are inserted.

A quantity of these steam pumping outfits were ordered by the British government in October, 1915, and another quantity were ordered in January, 1917, which is evidence enough that they have proved satisfactory in actual service.



Consisting of a 14-inch steam automobile boiler and a pulsometer steam pump, this equipment is being used in large numbers for pumping water out of the British trenches in France

The Largest Steel Water-Pipe Casting

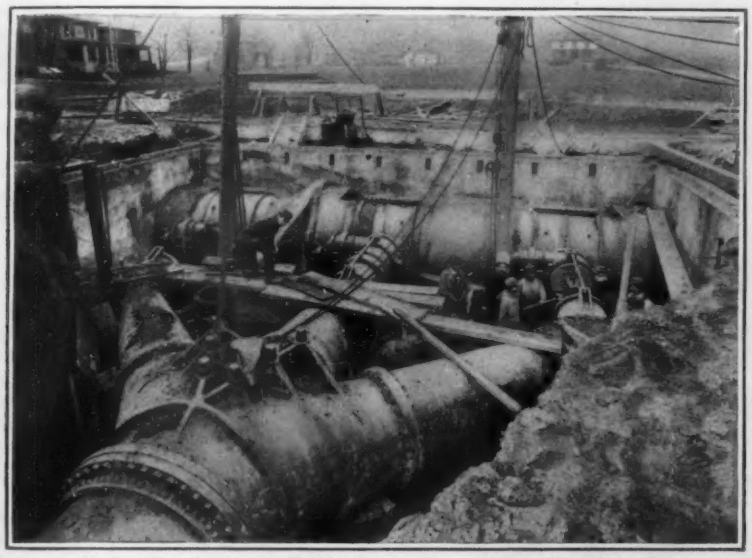
THE largest water pipe of steel ever cast is shown by the accompanying illustrations. It is also one of the most difficult castings that was ever successfully poured of steel.

Its size is unusually large, the diameter being over 5½ feet at the large end. A distinguishing feature is its design, accounting for the difficulties encountered in casting it. Besides the large opening, there are three others at the other end of the pipe. These constitute branches for connection to other pipe lines. The diameter of these is not small. An unusual feature is the six cylinders or encased holes which traverse the main part of the pipe. These can be seen in one of the illustrations and serve the purpose of spaces through which the holding-down bolts go, instead of drilling holes through the pipe to accommodate them. The bolts are thus also better protected and last longer. But the successful casting of such into such a pipe is in other respects most difficult.

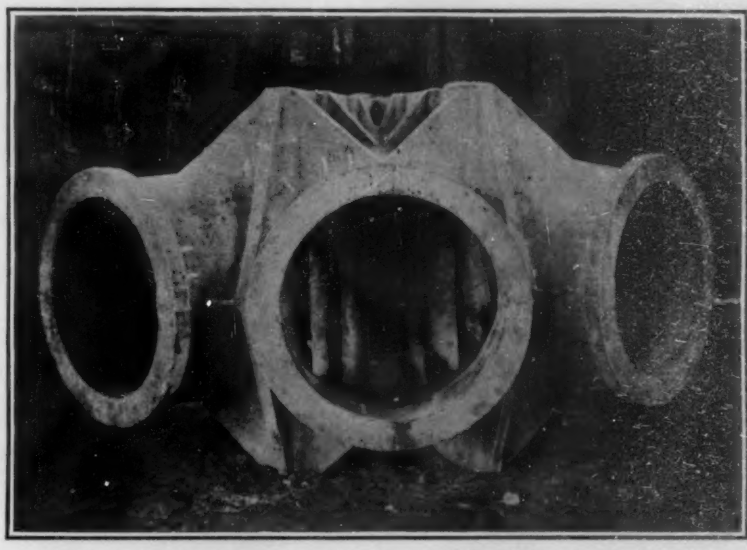
The pipe itself weighs 21,390 pounds, and is 2½ inches thick. It was especially made for the high pressure fire system of Pittsburgh, Pa. Cast-steel pipe is being adopted for this purpose quite extensively and this is an unusual instance. The steel pipe are much stronger than older types.

The special connection for which this unique pipe was cast is shown in one of the illustrations which also clearly indicates how the holding-down bolts are applied. The pipe is really a 3-Y pipe It was made by a large steel foundry in Chester, Pa., which specializes in high pressure steel castings. It is a plain carbon steel, annealed, and not an alloy steel.

This novel pipe casting is interesting in many ways, but mostly because it illustrates the high degree of skill of the modern foundry worker.



Laying the giant triple Y-joint water-pipe casting. Note how the holding-down bolts are applied



The largest water-pipe casting, showing the bolt-cylinders inside to make possible proper anchoring

Determining the Heat-Insulating Efficiency of Materials

STUDY of the results of an investigation of the heat-insulating efficiency of various materials has been made by the United States Bureau of Standards, and although absolute statements would not be warranted at the present stage, certain preliminary conclusions have been stated. In general, it appears that gypsum shows a greater efficiency as a fire-resisting material. Concrete and clay vary somewhat, depending upon their porosity. The denser clays conduct the heat a little more rapidly than concrete. The more porous clays, however, conduct heat somewhat less rapidly than the concrete. The effect of the aggregates on the concrete is not very marked in changing the relative conductivity. There is little difference in this respect between gravel, trap rock, slag, and soft coal cinder aggregate. Limestone concretes stand out as giving a much lower conductivity. There was found to be but little difference between the behavior of the gypsum specimens furnished. The dense high-plaster mixtures give much better results than the porous low plaster, high water mixtures.

The Heavens In June, 1917

Some Giants in the Universe of Suns

By Prof. Henry Norris Russell, Ph.D.

THE constellations of summer are now splendidly displayed in the later part of the evening. Facing due south, we may begin with Scorpio—one of the relatively few groups which was evidently named on account of its real resemblance to a familiar object—in this case, fortunately, more familiar to the inhabitants of Oriental countries than to ourselves. The long line of bright stars, which runs down from the brilliant red Antares almost to the southern horizon, and then curves back into better sight, must have suggested at once the similarly curved tail of a scorpion to all those who had early learned to dread the venomous creature, and very little imagination is needed to complete the figure. In classical times the Scorpion was better visible from northern latitudes than it is now, for, on account of the precession of the equinoxes, it was even more than five degrees nearer the celestial equator than it is now, and stood correspondingly higher in the sky. The constellation was also larger in early days than it is now—not because anything has happened to the stars composing it, but for the reason that the Scorpion's claws, which extended almost to the feet of Virgo, were amputated in later classical times to form Libra, the balance, the only one of the twelve constellations of the Zodiac which belies the name of this zone of images, because it is not the representation of a *living being*.

Though the Scorpion has lost its claws, Antares still marks its heart, and the splendid white star Lambda Scorpio—one of those which most narrowly fails of being classified as of the first magnitude—shows where the creature carries its sting.

These two stars are among the greatest luminaries of which we have as yet any certain knowledge. Both of them, along with most of the other conspicuous stars of the constellation, belong to the great moving cluster of stars discovered and investigated some years ago by Professor Kapteyn. As a result of his careful discussion, he finds it possible to determine the individual distances of the various stars of the cluster with a degree of accuracy which is truly amazing in view of their great remoteness. The two stars just mentioned are at approximately equal distances from us, and so far away that it takes their light fully 360 years to make the journey.

If removed to this distance, our sun would appear only as a star of the tenth magnitude, utterly beyond the range of unaided vision, and not easy to see with a small telescope—and even the splendid Sirius, which outshines the Sun more than twenty fold, would be invisible to the naked eye to appear as bright as it does. Antares must actually be 3,500 times as bright as the sun, and Lambda Scorpio though not quite as brilliant, must exceed the sun in light more than 2,000 times.

The contemplation of such prodigious brightness naturally leads to the inquiry: How are such things possible? What can these tremendous lamps of the firmament be like? Modern investigation makes an answer practicable, but shows as well that the reasons for the stars' brightness are not in all cases the same.

Lambda Scorpio affords the simpler case of the two, for it shows every evidence of being an exceedingly hot body. Its spectrum is conspicuously of the "helium" or "Orion" type, showing those lines which are known from laboratory evidence to be produced by gases under extremely violent excitation; and, further, its light is brilliantly white.

From this evidence it is possible to estimate that the temperature of its surface is probably from 20,000 to 30,000 degrees Centigrade, as against 6,000 degrees for the Sun—and that it gives out, per square mile of surface, something like thirty or forty times as much light as the Sun. From this we find that to account for its actual brightness, it would have to be of about seven or eight times the Sun's diameter—say six or seven million miles. This is pretty big compared with our ordinary standards of measurement, but is minute indeed, compared with the enormous distances which separate the stars, so that this star would look no bigger to us than a ball 1 inch in diameter would appear if viewed from a distance of 5,000 miles.

Antares, however, tells us quite another story. Here we have a star even brighter yet, and yet with every mark of low temperature. Its light is exceptionally red, and in its spectrum appear the heavy bands which prove the presence of the vapor of titanium oxide, a chemical compound which is broken up into its elements if the temperature is raised to the level of the hotter parts of the electric arc—let alone the far higher temperature of the Sun. To assume that the average temperature of the surface of such a star is 3,000 degrees, or 3,500 degrees at the very outside, is to go as high as we reasonably can; and, under these conditions, the amount of light emitted from a square mile of the star's surface can at most be 4 per cent of that which escapes from an equal area of the solar photosphere, and may be as low as 2 per cent, or even less.

But Antares is 3,500 times as bright as the Sun! Unless we are to assume that the ordinary laws of nature do not apply in this case, we must conclude that the area of this star's surface is at least 25 × 3,500, or 87,000 times that of the Sun, and its diameter hardly, if at all, less than *three hundred times that of the Sun, or 250 millions of* miles. Such a body would be bigger than the orbit of the Earth, and would fill up the whole inner part of our solar system. Yet, at the distance of Antares, it would appear to be only 1-40 of a second of arc in diameter—too small to detect as a disk with even the new 100-inch telescope at Mount Wilson, though perhaps just within the power of a telescope of twice the aperture, should such ever be constructed.

At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

NIGHT SKY: JUNE AND JULY

Many other stars are known—such as Arcturus and Aldebaran—which must be much larger than the Sun, exceeding it twenty, thirty or perhaps fifty fold in diameter: but no other has yet been investigated which approaches the enormous dimensions of Antares. It may be added that there is good reason to believe that, though it exceeds the Sun many million times in *bulk*, it has by no means a correspondingly great *mass*. Within its ample confines there may be stuff enough to make twenty, fifty—perhaps even a hundred suns, like ours; but, even so it must be a sphere of highly rarified gas, of density lower than that of the air which we breathe, and appearing luminous only because of its high temperature and enormous thickness.

Returning to our study of the constellations, we find in the south, above Scorpio, the tangled figures of Ophiuchus and Serpens. The long line of stars which begins just south of Corona Borealis, and runs down above Scorpio, and roughly parallel to the line of its tail, perhaps suggests a serpent; but the conventional figures drawn on old-fashioned maps are differently placed—the Serpent's tail running eastward towards Aquila, while the middle of his body is concealed by that of the giant who holds him. The head of Ophiuchus, marked by the star Alpha Ophiuchus of the second magnitude, lies to the northward, while his feet rest on Scorpio.

Below and to the left is Sagittarius, looking not in the least like an archer, but with a conspicuous, though small, group of stars known as the Milk Dipper, from its position in the Milky Way.

In the southeast low down, appears the head of Capricornus, marked by two stars, pretty close together, of which the upper one is double. Above this is Aquila, with the fine white star Altair—fully of the first magnitude, and one of our near neighbors in space. Still higher, and to the left, are Cygnus, the Swan, flying northward along the Milky Way, and Lyra, with the steel-blue Vega, the brightest star in sight. Above this, and extending to the zenith, is Hercules, and beyond, on the opposite side of the point overhead, we find Corona Borealis and Boötes the latter bearing the great orange star Arcturus, the only visible rival of Vega in brightness.

Leo and Virgo occupy the western and southwestern sky. Below the latter are Corvus and the tail of Hydra, and the northern oart of Centaurus can be seen, close on the horizon.

Ursa Major is high in the northwest, Draco and Ursa Minor are in the north, above the pole, and Cepheus and Cassiopeia in the northeast, and lower down.

The Planets

Mercury is a morning star all through June, but is best seen around the date of his greatest elongation on the 11th, when he is 23½ degrees from the sun, and rises at 3.30 A.M. He is then in Taurus, about 8 degrees south of the Pleiades, and appears like a star of magnitide 0.6—that is, about equal to Procyon. Mars is close by, and is in conjunction with Mercury on the 11th, being 3½ degrees north of him, but appearing more than a magnitude fainter.

Venus is an evening star, and comes out from the twilight into plain sight during the month, setting at about 8.40 P. M. at its close.

Jupiter is a morning star, and early in the month is close to Mercury and Mars. On the 8th, all three planets are within a circle 4 degrees in diameter. Jupiter is far the brightest of the three, and is intermediate between the others in position. Mercury being about six times fainter, and 3 degrees south of him, and Mars one-third the brightness of Mercury, and 40′ north of Jupiter. This conjunction of three planets will be well worth rising early to see.

Saturn is an evening star, in the western part of Cancer, and almost in line with Castor and Pollux. He sets at 10.30 P. M. on the 1st and 8.50 on the 30th.

Uranus is in Capricornus, and crosses the meridian at 4 A. M. in the middle of the month. Neptune is in Cancer, a little east of Saturn, and is visible in the early evening.

The moon is full at 8 A. M. on the 5th, in her last quarter at 2 A. M. on the 12th, new at 8 A. M. on the 19th, and in her first quarter at 11 A. M. on the 27th. She is nearest the Earth on the 8th, and farthest away on the 24th. As she travels around the heavens, she passes near Uranus on the 10th, Jupiter, Mercury and Mars on the 17th, Venus on the 20th, Saturn on the 21st, and Neptune on the 22d.

Comets

Mellish's Comet, whose discovery was reported last month, was conspicuous to the naked eye, at stations where atmospheric conditions proved favorable, for a short time near its perihelion passage, but is now far away again and faint. A second comet was discovered by Schaumasse, at Nice, on April 25th. It was then a morning object in Pisces, but has moved rapidly, and is now in the evening sky.

The preliminary orbit, computed by Mr. Einarsson and Miss Young at the University of California, gives date of perihelion passage as May 19th, the perihelion distance as 71 milion miles, the inclination 21½ degrees to the plane of the ecliptic, and the motion retrograde. At the time of discovery it was rapidly approaching the Earth, moving northward in the sky, and growing brighter. An approximate calculation, extending the published ephemeris, which has run out, shows that its nearest approach to the earth—about 34 million miles—comes on May 23d. Early in the month it should be visible telescopically. By the end of the month it will be so far from the earth, and so near the Sun in the sky, as to be seen with difficulty, if at all.

Princeton University Observatory. May 21, 1917.

Gold Dredging at Sixty Below Zero

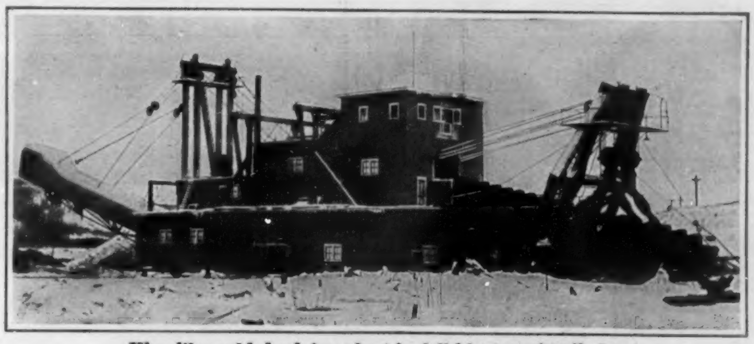
By Claude H. Bermingham

DREDGING gold in 90 degrees of frost is the latest achievement of the Klondike region. A strip of ground four miles up the Klondike was worked out, operating through the entire Yukon winter season without mishap or considerable loss of time. With the thermometer standing as low as 64 below zero, Fahrenheit, the lowest recorded during the winter, the gold-digger ran night and day as steadily as in the open summer season. Moreover, it was a complete mechanical as well as financial success.

The dredge is driven by hydroelectric power from the North Fork of the Klondike, and is heated throughout with steam, the stacker being covered in with a canvas hood.

The ditch conveying the water to the power plant is kept free from ice in a simple way. In the fall the ditch is filled with water and allowed to freeze. When the ice is two or three inches thick, the water is lowered, and there remains a natural roof of ice which keeps the frost out. Besides this, however, 1,000 kilowatt hours are turned back into the ditch in the form of electrical heat through the medium of apparatus stationed at the intake and pressure box.

The dredge pond was kept open without artificial means, except that some of the ice as it broke loose was held back from the dredge with booms. The buckets cut along a face 240 feet wide, sometimes digging as deep as 33 feet, 18 inches of which was frozen shell on the surface. The dredge pond immediately occupied by the dredge was kept practically free from ice, but 50 feet astern the water froze so solid in a few hours that a team could cross it. The two big dredges worked 2,527 hours in December and January, standing idle only 268 hours, giving an efficiency figure of 90.41 per cent—under the conditions, a remarkable showing.



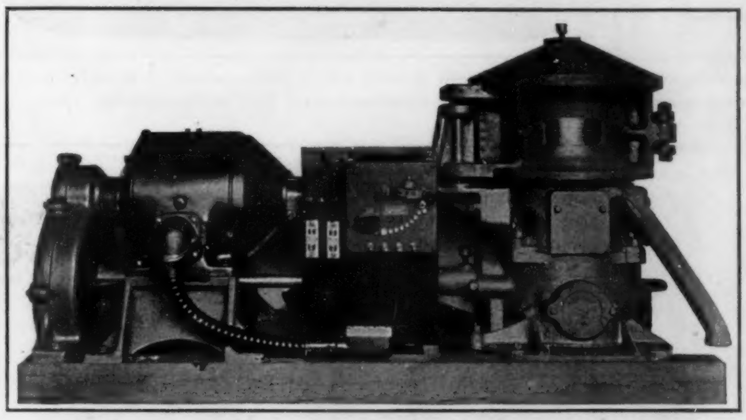
Klondike gold dredging plant in full blast at sixty below

When Coal Is Not Coal—Until It Is Analyzed

THE purchase of coal by chemical and physical analysis is a growing practice. Coal users insist upon knowing what they are to get for their money, and coal miners should know what they are supplying. All Government coal contracts are placed on a British Thermal Unit basis, and many large public service corporations and industrial concerns make their purchases by analysis.

The coal sampling called for by this procedure has been a tedious operation, as all of the quatering and crushing has been done by hand. The results have been unsatisfactory, for hand methods are not capable of a sufficiently uniform mixture on the large scale necessary to give a representative result. The analysis of the frequently non-representative sample thus obtained has led to much waste of money. Unwarranted complaints have often been based upon such analyses, and sometimes even unjust premiums have been paid or penalties exacted.

On the other hand, properly taken samples of coal are of great value, for correct analysis will assist the coal operator to direct intelligently the working of his mines and the preparation of the coal or coke produced. They aid the sales department in placing the coal where it will give the best satisfaction, and they make it possible for the consumer of coal to buy intelligently and to secure the fuel best adapted to his needs. But non-representative samples are worse than valueless under all circumstances.



This machine pulverizes coal and takes a representative sample for analysis

Recently an electric machine has been developed which automatically crushes and samples the coal in one operation, in large or small quantities. What has heretofore required hours or days to perform by hand methods and in a manner only partly satisfactory, is now accomplished in minutes; and any coal miner or user can, with little expense, know just what he is selling or buying, and soon save the cost of the machine. The coal is fed into the hopper in three-inch pieces (or finer) and is subject to gradual reduction until discharged at the bottom of the machine. Thorough mixing is insured; and a sample spout, placed opposite the main discharge opening, abstracts a certain percentage of the mixture and delivers it separately. The sample thus secured is exactly representative of the whole, with the correct proportions of slate, sulfur, fast and slow-burning coal, and everything else that is in the original charge fed to the testing machine.

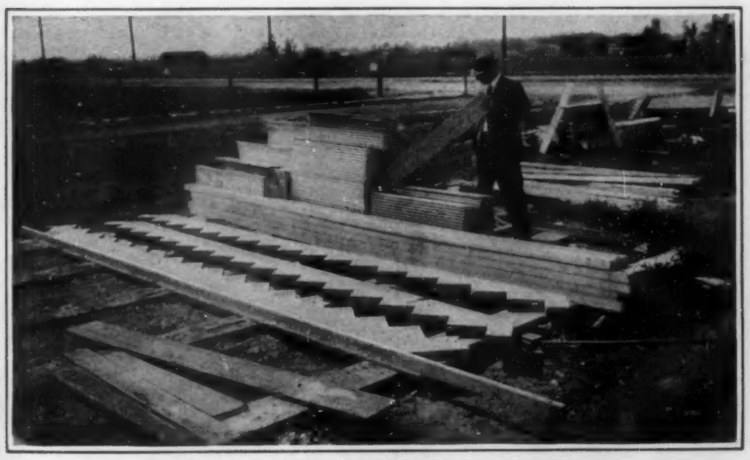
As our illustration shows, the machine is simple and compact, yet amply strong enough to perform its duties. It runs at low speed without vibration, and can be adjusted to deliver a uniform product in any desired size from one-quarter to three-quarter inch.

New Method of Building With Concrete "Boards"

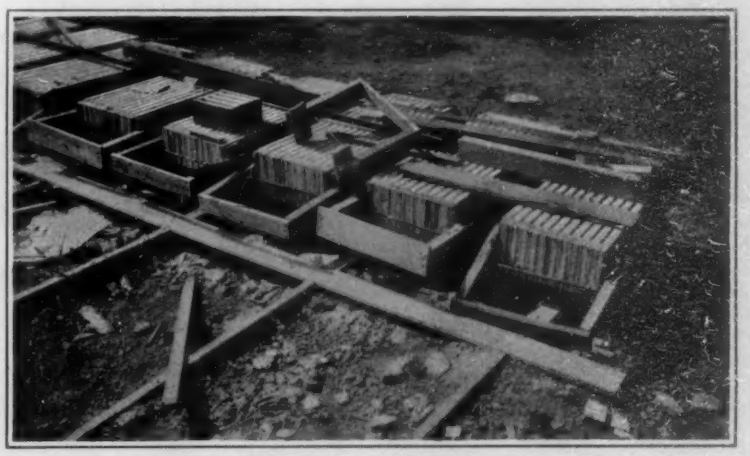
BOARDS of concrete, with joists, rafters and stair frames of the same material, are used in the construction of a novel building in Los Angeles, Cal., the whole being set upon a concrete foundation. Though put together after the manner of a frame structure, the building is as fireproof and durable as the more common types of cement houses, but it requires less material and is lighter in weight.

The various parts are poured into forms on the ground near the site, and in that way the danger of breakage is eliminated. The photographs indicate how the different parts are made: the clapboards are poured in sets of ten, the forms being securely clamped together, and the cement allowed to harden in them for several days. Then they are taken out and allowed to cure before being set up. This should be done while the preliminary work is going on, such as excavating and laying the foundation.

The joists, rafters and other parts are formed in the same manner, and various types of reinforcing are used for each. The boards are reinforced with mesh like chicken wire, while the timbers have iron rods of varying thickness to strengthen them. These are allowed to project at one end in order to fit into corresponding holes in other timbers, so that the whole framework dovetails. The method of attaching the boards to the 2 x 4's is with nails, and nailholes are bored into the cement boards before they have set, by running a wire through them. As the cement timbers will not take the nails, a strip of wood about an inch and a half thick is wired to the cement scantling. The advantage of this type of concrete structure is that it is light in weight and therefore does not require a very heavy foundation, and the building method allows an air space between the outer wall and the plastered interior.



Stair-frames, boards and timbers of concrete



Forming the concrete boards in sets of ten

This looks like a frame house, but all the parts are of concrete

Determining the True Length of Yarns

THE Bureau of Standards has been grappling with the fact that, owing to the elastic nature of yarns, it is difficult to determine their true length. The tension applied to straighten the yarn, for the purpose of measurement, increases its normal length. The Bureau has, however, devised methods of computing the normal length of yarns from a series of measurements under various tensions. The tension necessary to produce this normal length may then be applied to all yarns of the same character, and the length measured with a relatively small error. This method is useful in determining the percentage of crimp in fabric yarns used for making automobile tires.

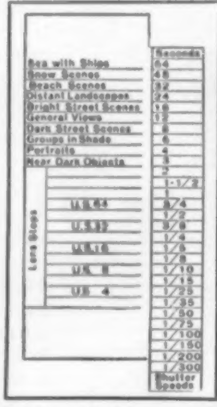
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

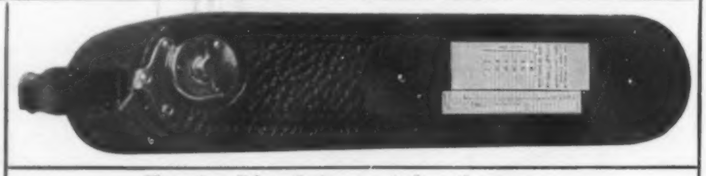
Making the Hand Camera Determine the Correct Exposure for Each Photograph

If the average amateur photographer fails to obtain good photographs at times, it is largely due to wrong exposure; for, as perfected as the hand camera is today, incorporating all sorts of devices tending to simplify the making of good photographs, there is no practical attachment that will accurately determine the exposure for each subject. True, there are scales which can be fitted over the ordinary shutter, and which, by classifying the subject and the light and adjusting the shutter accordingly, will make for good results; but so much depends upon the correct classification of the light—a most difficult matter at times—that these scales are of little value in the hands of the average amateur. There are many types of exposure meter which are excellent; however, since they do not form an integral part of the hand camera, they are rarely available when wanted.

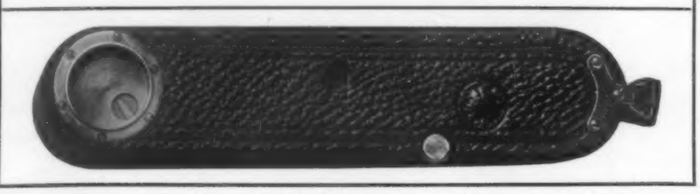
The ideal solution of the exposure problem, then, is some form of exposure meter which is built into the hand camera with which it is to be used, and this is precisely what H. L. Ide, of Springfield, Ill., has invented and patented. This latest camera improvement consists of a piece of specially-treated bromide paper which, upon exposure to light, prints to a green tint, and which is cemented to the metal end of the spool of the usual film cartridge, while upon the camera case there is provided a suitable means of exposing one section of the paper disk at a time, and of making a comparison between this discolored section and a permanent color tint. The seconds or minutes required to bring the sensitized paper to match the permanent tint gives the user the light value, and with this factor a simple slide rule attached to the camera makes the necessary correction for the class of subject to be photographed, and all shutter speeds and lens openings.



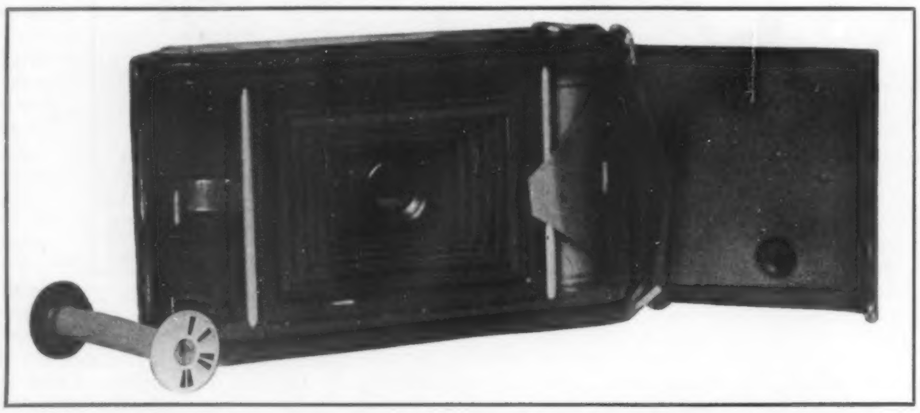
Graduated slide rule used with the exposure meter



How the slide rule is mounted on the camera



Narrow slit through which light is admitted in order to discolor the sensitized paper disk on the cartridge spool



Folding camera with its back removed, showing the film wound up at the right and the empty spool at the left. Note the discolored sections of the paper disk on the empty spool

The inventor has borne in mind the importance of maintaining the daylight-loading feature of roll-film photography, and accordingly has devised an ingenious method of protecting the sensitized paper disk until it is in position in the camera. This feature—not shown in the accompanying illustrations—is made possible by using a metal clip which is provided with a circular member fitting over the end of the spool, completely masking the paper disk. After the film cartridge has been inserted in the camera, in broad sunlight if necessary, the clip is removed and the sensitized paper is then ready for use.

Exposure of the paper disk is made through a narrow slit, so that only a small section is utilized at one time. In exposing the paper the user should prevent direct sunlight from entering the slit; in other words, the exposure should be made in the shadow of the user's body. A fresh surface of paper can be brought into position when desired.

To illustrate how simple the device is to operate, a typical application may be cited: The paper is exposed and the time required to discolor the section is noted. Suppose the time is six seconds; then turn to the slide rule on the camera and select the subject to be photographed. Should it be a "Beach Scene," move the narrow numbered rule on the right until 6 is opposite "Beach Scene," and in this position glance down the scale to the lens stop which is to be used, say U. S. 4, and read opposite this—in this case 1/150—which gives the shutter time. Thus with an exposure of 1/150 second a correctly exposed negative will result. If a smaller stop is desired, then read opposite say U. S. 8, and the correct exposure is then 1/75 second. Now if instead of a "Beach Scene" the subject is a "Dark Street Scenes," set the narrow numbered scale with the light value (6 seconds), opposite the subject "Dark Street Scenes," then read down to the number opposite U. S. 4, and the exposure necessary is found to be 1/35 second.

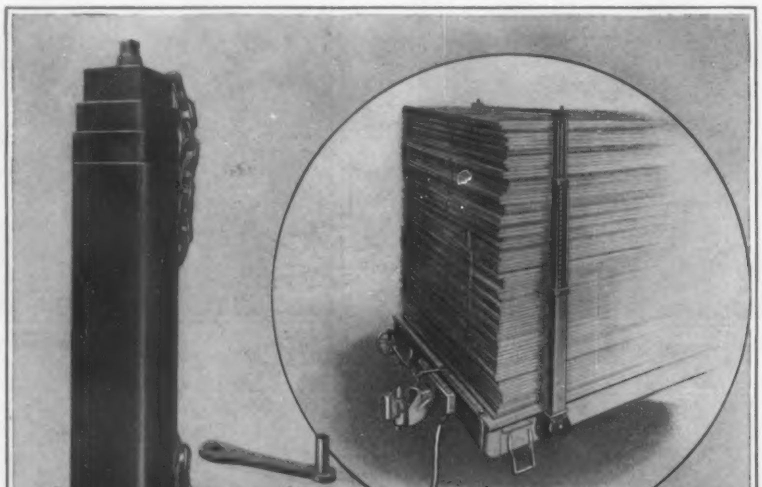
Eliminating the last vestige of guesswork in amateur photography, this new device should go far toward solving the problems of the tyro. For this invention allows for the variation of actinic light values during winter and summer months and in different latitudes. So, no matter where the amateur may take pictures, it serves to put at his disposal a knowledge of light conditions which will insure perfect photographs.

A Telescopic Stake That Does Away with Wooden Stakes on Railroad Cars

With full knowledge of the numerous disadvantages of the present-day wooden stakes used for protecting goods placed on railroad flat cars, a New York inventor has just introduced a telescopic stake for which many advantages are claimed.

The new telescopic stake, it will be noted by studying the accompanying illustration, is made of three sections of channel-bar steel, the top section telescoping into the intermediate section, and the intermediate section into the bottom one. The movements of each section are controlled by means of screws, which allows the stake to be extended upwards as the load on the car increases in height. In this way the stake never projects above the top of the load until the car is completely loaded, and therefore does away with the breakage of stakes so common with wooden stakes which are in universal use. In unloading the operation is reversed. As the load is taken off the car, the stake is screwed downwards until it is completely telescoped.

Made in two ways, the new steel stake meets all requirements. One of these ways is to provide the stake with a tapered end made to fit a standard socket. The other way is to supply the stake with a rounded end which goes in a circular covered disk. This disk is cut so that the stake cannot fall downwards; it can never go any farther than parallel with the floor of the car. When the car is not in use the stake lays parallel, and when the loading is commenced it is stood upright and a bolt is placed behind it to hold it in place. The bolt it revolves on goes completely through the sill of the car and passes through the corresponding stake on the opposite side. This makes it practically unbreakable as the car would have to be wrecked before the stake would come loose. It will be noted that the stake is provided with a chain for holding goods in place.



This hinged, telescopic steel stake does away with the conventional makeshift wooden stake. Its application is shown in the insert drawing

Although the first cost of the steel stake is obviously many times greater than the conventional wooden stakes, in the course of a short time it pays for itself several times over. For one thing it is permanent, whereas the wooden stakes are seldom used for more than one journey, after which they are lost, discarded, broken or stolen, while a like fate befalls the wire used in conjunction with them for holding the goods in place. A wooden stake weighs about 90 pounds, the steel stake 150 pounds. But then it requires 16 wooden stakes to a car, or 1,440 pounds, while 12 steel, or 1,800 pounds, will serve the same purpose and prove far stronger with only some 360 pounds of additional weight. Finally, the wooden stake at its best is but a makeshift, whereas the telescopic steel stake is always at hand and its operation makes for the greatest efficiency.

Stinging Nettles Cultivated for Textiles

The old industry of cultivating and using stinging nettles for textile purposes has recently been revived in Germany and Switzerland, on account of the shortage of cotton. These plants, generally regarded as troublesome weeds, also provide food for both human beings and cattle, the young tops being used in the former case, and the dried shoots in the latter.

RECENTLY PATENTED INVENTIONS

Electrical Devices

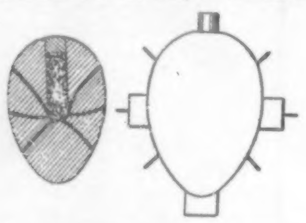
ELECTROLYTIC RECTIFIER.—C. C. RUPRECHT, Midway, Fla. In the operation of the rectifier the solution is decomposed by the passage of electric current, hydrogen and oxygen being liberated, and the salt or salts or chemical being decomposed and changed. By continued use the solution loses more and more of the original salts which may assume a non-soluble form, and the resulting combination deposits at the bottom of the retainer. The invention's purpose is to render the rectifier more reliable and free from the objections in the ordinary type of rectifier.

ELECTRICAL MEASURING INSTRUMENT.—W ANTHONY. Address Dewey & Dewey, Attys., Clyde, Ohio. The invention relates to measuring instruments, especially pocket voltmeters and ammeters. It provides an improved instrument over that set forth in a prior application, Serial Number, 16,648, in which a needle is acted on by a coil, the deflection of the needle being proportional to the current passing through the coil.

Of Interest to Farmers

HOLDING DEVICE FOR LIVE STOCK.—J. W. TROXELL, Breckenridge, Ill. This invention relates to a structure adapted to be positioned in an opening through a fence, in a doorway or other situation and adapted to hold live stock while being dehorned, branded, or in ringing or snouting hogs, or vaccinating stock, or performing other operations thereon.

PROCESS OF MAKING MEDICATED NEST EGGS.—J. G. BURNS, Pulaski, Tenn. The egg is of that type in which the agent for killing lice, mites, etc., is in liquid or semi-liquid form and sealed in the body of the egg and is adapted to pass out through the walls to the surface. The invention improves the construction of articles of this character so as to be comparatively cheap to manufacture, easily re-charged and serviceable for a long period of time.



PROCESS OF MAKING MEDICATED NEST EGGS

GRASS SCORCHER.—B. C. RUSSELL, care of Odessa Farm, Winfield, Kan. The invention provides a machine for scorching and killing grass and the like, in newly mown alfalfa fields, from which the crop has been removed, without injuring the alfalfa. The mechanism is capable of ready adjustment for controlling the flames from a series of burners within a narrow prescribed area, whereby to prevent the prolonged exposure of the grass to the flames without a resultant firing of the same and consequent injury to the alfalfa crops.

Of General Interest

HAND BAG AND LIKE ARTICLE.—L. LOWENSTEIN and S. ROBBINS, 851 W. 181st St., New York, N. Y. This invention provides improvements in hand bags, satchels, purses and like articles, whereby the time and labor required for fastening the bag in position in the framework is reduced to a minimum and at the same time the bag body is securely fastened in position in the frame and without danger of any portion of the bag pulling out or becoming detached.

FOOD PRODUCT.—K. KANZAKI, care of H. K. Kiso, 15-21 Park Row, New York, N. Y. An object here is the production of a flour from a natural plant known as awa, grown almost exclusively in Japan. Another object is to produce a flour composition by mixing the flour from the seeds of the awa plant with flour from wheat or rye.

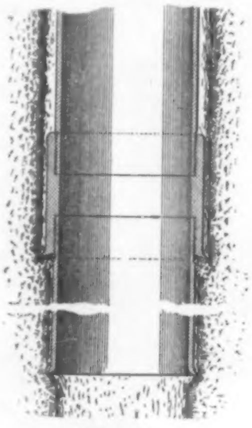
ATTACHMENT FOR FOUNTAIN PENS.—J. F. CONWAY, 1215 Flatbush Ave., Brooklyn, N. Y. The improvement relates to attachments for fountain pens and has for an object the provision of an arrangement for supporting the pen in proper position when resting or a table so that the ink will gravitate away from the pen point.

SUBMARINE SUPPLY.—P. L. E. DEL FUNGA-GIERA, Box 1200, New York, N. Y. This invention relates to a system of carrying such auxiliary supplies as is necessary for the proper maintenance of submarine vessels or other surface or undersea craft, and is characterized by a tank or tanks constituting a container or containers so equipped as to permit of the supplies being removed at will at the surface, and having anchoring means whereby the containers may be positioned in convenient localities.

BOX STRAP.—P. J. FORBES, care of De Haven Mfg. Co., 50 Columbia Heights, Brooklyn, N. Y. This inventor provides a box strap which is exceedingly strong and cheap to manufacture and provided with nailing apertures for the passage of nails used to fasten the box strap to a box or other package on which the strap is to be used to reinforce such box or package.

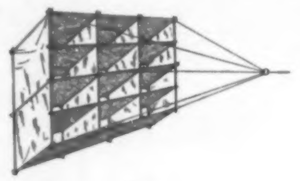
COMPRESSIBLE FLUID WASHER.—A. W. LISSAUER, care of Horwitz, 115 Broadway, New York, N. Y. The improvement pertains to a washer for elastic fluids. An object thereof is to provide a simple, inexpensive and convenient device for eliminating extraneous particles that may be carried by an elastic fluid and through which a maximum of elastic fluid may pass with a minimum of friction.

CASING SHOE.—G. NYMANNING, care of Robert Heath, Box 507, Taft, Cal. This improvement has reference more particularly to a shoe extension, an object of which extension is to prevent water from the strata above the shoe from filtering past the casing shoe and flooding the portion of the well below the casing. It eliminates in many cases the necessity of cementing the portion of the well above the shoe to prevent water from the strata above the casing shoe from penetrating to the well below.



CASING SHOE

KITE.—A. L. GRAHAM, 936 Bush St., Santa Rosa, Cal. Mr. Graham's invention relates to kites of cellular structure characterized by the ability to fly without any auxiliary stabilizer. He provides a simple and efficient cellular kite, each cell having inherent stability and serving as a stabilizer for the coöperating cells. The cellular structure may be increased indefinitely with a gain of efficiency, a condition which is impossible with the ordinary box-like kite.



KITE

CUP REMOVER.—A. FRITSCHE, 118 E. 11th St., New York, N. Y. This invention refers to devices used in the manufacture of cups forming part of artificial flowers, and has for one of its objects the provision of an improved arrangement whereby the cups may be removed from their holders quickly and easily without injury.

CLOSURE.—J. A. POWER, Hampton, N. J. The invention relates to means for closing openings in the sides of cylindrical or other curved vessels, as for instance in the side of a boiler, and the main object thereof is to provide means for insuring a positive seat for the nuts as well as a positive support for said seats to prevent the creeping of the closure as is common with the conventional washers interposed between said closure and nuts.

MULTIPLE-PLATE REINFORCED GLASS AND PROCESS OF PRODUCING SAME.—ABEL BARDIN, Paris, France. This invention has to deal more particularly with a multiple-plate reinforced glass in which the individual plates are united or cemented together to form a unitary article. It provides a reinforced and armored transparent multiple-plate glass in which the reinforcing substance is thoroughly protected by the coated sides of the plates of glass being placed in contact and united.

PAPER HANGER'S KIT.—S. FAZZINI, 69 W. 107th St., New York, N. Y. This invention provides a collapsible kit or case which in one position, as for transportation, is adapted to hold all the tools ordinarily used by the paper hanger, except possibly his straight edge, the kit in this position simulating an ordinary suit case in size and appearance, but the kit is so constructed that when it is opened out it will provide a complete cutting and paste-applying table.

TOILET NOVELTY.—BELLE R. KANTROWITZ, 1057 Taite St., Bronx, New York, N. Y. The object of this invention is to provide a simple, compact and useful toilet novelty which can be fashioned from any suitable ornamental or other material, which serves a refillable powder puff for applying face powder, and also as a receptacle for objects such as hair pins and a mirror, which, when closed, is substantially flat, and takes up a comparatively small space, which can be inexpensively produced, and from which the face powder cannot inadvertently escape when the article is closed and not in use.

Hardware and Tools

COMBINATION PLIERS.—L. TERZAGHI, 203 Bleecker St., New York, N. Y. This invention provides an arrangement whereby certain parts are so combined as to assist in performing several functions in order that the pliers may be used for a large number of different purposes. The pliers have jaws of such shape as to be used as a hammer, as a pinching structure, as pliers and as a pressing means for garments.

SYRINGE.—H. LAURENT, East Rutherford, N. J. This invention relates to syringes having a rubber plunger reciprocating in a glass barrel and provides a syringe arranged to prevent the rubber plunger head from sticking to the inner surface of the barrel on reciprocating the plunger even if the syringe has not been used for some time. The invention insures proper fitting of the plunger head in the barrel even should the bore thereof not be true.

ANTIRATTLER DOOR LOCK.—C. J. HAGSTROM, Maple Ave., Glen Cove, N. Y. One of the principal objects of the invention is to provide a lock for a swinging door, the catch of which is hidden or retracted within the casing when the door is opened and which is automatically thrown into holding or locking position when engaging a number on the door frame.

TRAMMEL.—R. A. NELSON, 1700 Fifty-fifth Ave., Oakland, Cal. This invention relates to a trammel or beam compass. It provides a means for adjusting the trammel point and for holding it securely in the adjusted position; provides improved clamping means to secure the device to a beam; and provides a novel caliper attachment that may be readily applied to the trammel points.

HOSE CLAMP.—A. P. SWAIDMARK, Concord, N. H. The invention relates to hose clamps and the object thereof is to provide such clamps of universal adaptability in that they may be fitted to hose of any diameter, thereby permitting a supply house to meet all demands with a much smaller stock than is possible with the clamps now in use.

LOCKING MEANS FOR SECTIONAL CROSSCUT-SAWS.—F. P. ROWLAND, Donnelly, Idaho. This invention relates to means to connect and lock the sections composing a sectional saw, the invention being particularly intended for use in cross-cut saws. It provides locking means whereby the sections may be quickly locked securely together and readily unlocked to detach the sections when desired.

BAND CLAMP.—J. G. ELKIN, 68 E. 131st St., New York, N. Y. Mr. Elkin provides a clamp more especially designed for use on hose-pipe coverings and like articles and arranged to permit of conveniently placing the clamp in position on the article and drawing the band tight around the article without danger of the band becoming accidentally loosened or detached after it is once applied.

NUTCRACKER.—A. G. PAXTON, Arcola, Miss. An object in this invention is the provision of a nut cracker having an adjustable nut seat whereby various sized nuts may be accommodated without necessitating further movement of the handles apart beyond an ordinary degree. The device is extremely simple and inexpensive to manufacture.

HOLDER FOR WHETSTONES.—A. L. WALKER, Box 49, Hoopeston, Ill. This improvement has for its object to provide a device capable of attachment to a table, wall, or other fixed support, and having means for holding the stone firmly in proper position for engagement by the blade of a knife or other tool to sharpen the said knife or tool.

STAMP RECEPTACLE.—S. BICKERTON, P. O. Box 13, Honolulu, Hawaii. This invention has reference to improvements in receptacles for stamps as well as the moisteners for the said stamps, and the object of the invention is to simplify and to improve the existing art by providing a device of this character which shall be simple, cheap and thoroughly effective in operation. The engraving shows a perspective view of the receptacle, the lid or closure being in its open position.

STAMP RECEPTACLE

DUST PAN.—W. PIGOTT, 104 E. Padre St., Santa Barbara, Cal. In this case the invention has for its object the provision of a dust pan having a scoop which leads up to a container for receiving the dust, there being an opening in the container for removing the dust and which is normally closed by a door.

DOOR LOCK.—H. REIN and J. R. COMBS. Address the former, 117 W. 87th St., New York, N. Y. This invention relates to door locks and some of its main objects are to provide such locks which are positively burglar-proof, which are adapted to use either as mortise or side locks, which are adapted for use on either right or left-hand doors, and wherein the several parts are reversible and interchangeable.

NOZZLE.—A. W. LISSAUER, care of E. Horwitz, 115 Broadway, New York, N. Y. This invention relates to nozzles for generating a spray of liquid in a finely divided state It provides a nozzle which will offer the least resistance to flow therethrough, which will not clog, which can be easily cleaned during the operation, and with which a maximum amount of liquid can be delivered with a minimum of initial pressure.

VISE.—C. G. KAELIN, 207 Masten Ave., Buffalo, N. Y. The purpose here is to provide a vise arranged to permit the user to securely clamp the work in place without undue physical exertion, and to insure a quick action of the movable jaw by reducing lost motion to a minimum. Another object is to permit convenient adjustment to compensate for wear.

Heating and Lighting

TORCH.—L. STETTNER, 884 Folsom St., Oakland, Cal. The invention relates to improvements in oxygen-acetylene torches, for welding or the like. It provides apparatus of the above mentioned character, having means for effecting an intimate and thorough mixture of the oxygen and acetylene gas, in desired proportions, such means also serving to prevent back-firing of the mixture

PRECAUTIONARY SIGN.—E. H. BOSTOCK, 229 West St., New York, N. Y. This invention provides a sign more especially designed for use over the exits of theaters, concert halls and other buildings and arranged to be distinctly visible in case the usual illuminating means should become extinguished for any reason whatever, thus enabling an audience to reach the exit in the dark and thereby preventing a panic in case of a fire or other disturbance.

Household Utilities

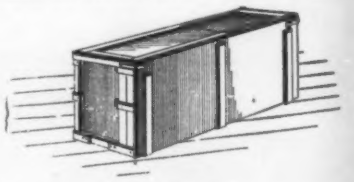
TABLE.—G. H. PACKWOOD, SR., Quartermaster Dept., Fort Myer, Va. This invention provides an exceedingly convenient, restful and comfortable article for use in ladies' dressing- or sewing-room, bachelor's-rooms, library, portico or club. It does not have to be moved as it is always in the right place when wanted. If something is needed while in use, all that is necessary in the operation is to swing the table to one side, which may be accomplished without disturbing anything on the table. When what is desired is procured, return to the chair and swing the table back into place, an operation which requires only one motion.

TABLE

PICTURE AND MIRROR HANGER.—J. J. COOK, Box 614, Monroe, La. In the present patent the object of the invention is the provision of an improvement in hangers for pictures and mirrors which shall be distinguished by simplicity and cheapness of construction, and by adaptation for easy adjustment to vary the angle or inclination of the frame.

ALTERNATE DRIVING GEARING FOR FREEZERS.—W. H. STEMPLE, care of Newberry College, Newberry, S. C. The invention provides an ice cream freezer wherein a tub is provided having the usual container mounted therein, and furnished with stirring mechanism, and wherein means is provided for rotating the container and the mechanism in opposite directions, or otherwise, with high power and low speed, or with low power and high speed, the rotating means being capable of being used simultaneously or alone.

MESS AND ICE BOX.—C. C. EDWARDS, 1447 E. Washington St., Phoenix, Ariz. This invention is an improvement in mess and ice boxes, and has for its object to provide a box that when in use will provide an efficient refrigerator or cupboard and which when packed will present a neat plain package of convenient size and that will meet the requirements for army use in regard to size. The engraving shows the box closed and ready for transportation.



MESS AND ICE BOX

SCREEN DOOR ATTACHMENT.—C. M. DEICKE, 2018 N. Washington St., Baltimore, Md. In this invention a "push lever" is pivoted to and carried by the screen door, and it is adapted to operate the push button of the bell fixed in position on the door casing. The lever is pivoted and supported on a bearing, and a forked spring is secured between the escutcheon plates in such a manner as to act on the lever and hold it normally away from the bell push-button. The engraving shows a partial view of a screen provided with the attachment, looking from the inside.

SCREEN DOOR ATTACHMENT

(Concluded on page 560)

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Mobilizing Our Medicine

(Concluded from page 550)

An army, a navy, in time of war needs its medical supplies badly; it needs them when it needs them, and it needs them fast. It is vitally necessary to have enough of essential things and to have answered in advance the question, what *are* essential things? Leave it to the manufacturer and his prejudice or education will dictate the answer. Hence the organization of manufacturers and the standard list of medical supplies, prepared and almost ready to be sent out, by which it is possible to curtail (if necessary) productive effort in valuable but not vital lines in the interest of specialization upon such drugs, instruments and accessories as are essentials.

Representatives of the Army, Navy, Red Cross, Public Health Service and many distinguished specialists have given time and thought to this work. Manufacturers of surgical supplies, laboratory and optical supplies and instruments, makers of drugs, medicines, hospital supplies, bedding, clothing, furniture, thermometers, surgical instruments—even cutlers—have coöperated. It can as a result be emphatically stated that this country is now prepared to handle the making and distribution of its medialc supplies quickly and efficiently in almost any quantity needed without an undue disturbance or unnecessary rise in price of supplies to civilian hospitals.

Many surgical instruments are difficult to make and can only be produced by trained instrument makers, of whom there are by no means enough in the world, let alone this country, to supply rapidly a sudden demand. But of the wilderness of tools which the surgeons find desirable, only a comparative few are absolutely essential. The factory which makes razors, table knives, pocket knives or tools can—and will—turn out excellent surgeons' tools of the simpler construction, when needed, just as lock and key factories can make various forms of laboratory apparatus, and the coarser articles of surgeons' equipment—operating tables, for instance.

But only a trained medical army or naval official, looking at the almost endless list of supplies in the standardized catalog would consider the matter simple. The endless details of the process of settling upon a scheme for standardization which reaches to the size of handles of knives and the type and kind of bottles, bowls and dishes for a laboratory, would be almost funny if the efficiency and speed with which the work has been correlated and mastered was not so awe-inspiring.

A part of the work of the Medical Section in continuation of the work so well begun by the Committee of American Physicians has been the taking of a census of civilian hospitals, their resources and possibilities. Exhaustive statistics of some fifteen hundred hospitals are at hand and available, showing the number of beds, the resources, the possibility of expansion, ground available, equipment, food and water supply—everything, in fact, that the military commander might want to know about places of care for his sick and wounded. This inventory includes also the resources of medical institutions other than hospitals, such as clinical laboratories, vaccine establishments, artificial limb factories, dental supply companies and factories, etc., etc.

Add to all this an exhaustive survey of the medical resources of Army, Navy, Public Health and Red Cross Services, so that one branch may be perfectly informed of the work of all others, a rapid and skillful promotion of research regarding the specific problems of modern warfare, which includes experiments of the highest scientific importance in dozens of research laboratories all over the country, the tabulation, indexing and digestion of over three hundred statements of surgeons and officers having personal first-hand knowledge of war-time medical problems as met on European battlefields, plans to increase the value, volume, availability, and efficiency of all medical resources both civilian and military, and it is not unbelievable that this mobilization of American medicine has run ahead of, rather than behind, the industrial and military preparedness of the country.

RECENTLY PATENTED INVENTIONS

(Concluded from page 558)

Machines and Mechanical Devices

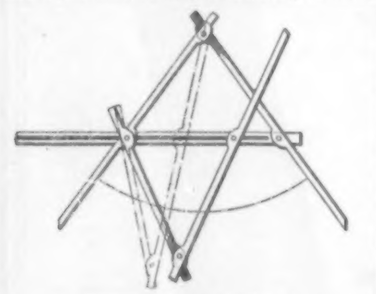
RECORDING ATTACHMENT FOR A LIQUID DISPENSING APPARATUS.—A. F. WILEY. Address H. B. Wiley, Nevada, Mo. An object of the present invention is the provision of a recording mechanism to be used in conjunction with a liquid dispensing pump, certain movable parts of the pump being utilized for actuating the recording mechanism to record the quantity of liquid dispensed.

GLIDING BOAT.—D. LA CHAPELLE, 158 Cedar Hill Ave., Nyack, N. Y. Among the objects of this invention is to construct a boat hull of the flat bottom or gliding type and adapted for high speed operation, providing for the least amount of shock to the occupants of the boat due to the impact while the boat is skipping or gliding from one crest to another.

MASSAGE APPARATUS.—J. SABATINO, 4757 Jerome Ave., Richmond Hill, L. I., N. Y. The invention provides a structure wherein the vibrating member and means for adjusting the same are arranged interiorly of a casing. It provides a vibrator apparatus rotating traveling means for adjusting the position of the vibrating arm or member.

WATER LIFT.—C. F. COUVE, 357 Weston Ave., Aurora, Ill. This invention relates to means for raising water and comprehends a water lift operated mechanically for the purpose of raising water from wells of considerable depth. The apparatus has the various parts so arranged as to present a minimum of liability to get out of order and particularly while working under considerable pressures.

INSTRUMENT.—J. A. CLARKE, Care of West Philadelphia High School, 48th and Walnut Sts., Philadelphia, Pa. This invention relates to mechanical means for trisecting any given angle, and provides for accomplishing this result without the need of any calculation, which is



TRISECTING INSTRUMENT

instantaneous in results, which may be used by an unskilled person by following very simple directions, and which is composed of few parts not likely to get out of order. The accompanying engraving shows in plan view the instrument ready for use.

PAVING MACHINE.—P. S. COYNE, Care of Sexton Oil Company, Peoples Gas Bldg., Chicago, Ill. In this patent the improvement provides a machine arranged to automatically place paving stones, bricks or similar paving blocks in position on the previously prepared foundations of a roadbed, and to hammer or drive the paving blocks into space against the transversely laid course, at the same time insuring proper alinement of the blocks.

LOG MOVING MACHINE.—F. R. HEWITT, Hewitt, N. C. This invention provides a machine for getting out logs from places inaccessible to the ordinary moving means for the logs, wherein a carriage is provided for hauling the logs, the said

LOG MOVING MACHINE

carriage running upon a track, and having reels upon which a flexible member as, for instance, a rope or the like, winds, wherein the reels are driven to wind up and unwind the rope to move the tractor in opposite directions.

HYDRAULIC MOTOR.—R. RIVERA, Sonsonate, Salvador, Central America. This invention provides a hydraulic motor in which the shifting of the valves to turn the motive fluid first in one direction and then in the other is accomplished automatically and instantaneously. It provides means by which this instantaneous shifting of the valves may be accomplished.

COMPUTING MACHINE.—J. R. COMBS, 420 W. 116th St., New York, N. Y. The improvement refers to means for mechanically registering the fewest of monetary denominations required to make each of a plurality of individual payments comprised in a total amount, such as the various sums which make up a pay-roll, or, in other words, to determine the total of the largest notes and coins necessary for each of a plurality of individual payments.

CRANK SHAFT.—J. E. HOLVECK, Pittsburgh, Pa. The improvement relates to crank shafts, and an object thereof is to provide a crank shaft in which the angular relation of the cranks is such that the total load on all the bearings of the shaft is more evenly distributed than is possible with the crank shafts in use at present.

SUGAR BREAKING AND PACKING MACHINE.—J. BARDET, Engineer, 35 Rue d'Alsace, Paris, France. This invention relates to improvements in machines for breaking and packing sugar. The invention simplifies the construction and improves the operation of the means whereby the sugar in the form of rectangular ingots is fed to the breaking blades to break them into pieces whereby the pieces of such ingots are fed to the pasteboard boxes used for the packing of sugar.

NEEDLE GUARD FOR SEWING MACHINES.—N. LEDERER, Room 1204, 404 4th Ave., New York, N. Y. In this case the invention has reference to the needles of sewing machines and the object thereof is the provision of a guard for such needles to prevent injury to the operator without interfering in any way with the usual machine operations. The guard may be made of any desired material.

CLUTCH ACTUATING MEANS.—C. NULL and E. A. BAKER, Rochester, Wash. This invention relates to friction heads of the type used, for instance, upon logging and hoisting engines the more particular purpose being to provide means for relieving the friction due to end-thrust of the hoisting drum, and also to distribute the strains due to such end-thrust, as well as to protect various parts from undue wear and breakage.

HEAD REST BARBERS' CHAIRS.—G. W. SPAHR, 324 Missouri Ave., East St. Louis, Ill. This invention relates particularly to head-rests for barbers' chairs and more especially to those head-rests employing sanitary means, usually paper, to cover the surface thereof, the object being in the first instance to do away with the usual waste of manual control and disposition of paper for each patron, and to regulate the same automatically.

SUGAR SEPARATING MACHINE.—L. M. CLAIRAIN and O. J. SUARES. Address J. W. T. Stephens, 427 Whitney Bank Bldg., New Orleans, La. In this machine the sugar is separted from the solution by fluid under pressure, as for instance, air, and wherein a conveyor is provided having a screen, and having means for dragging and spreading the mixture over the screen, exhausting apparatus being arranged below the screen to draw the solution through the screen, leaving the granulated sugar on the screen.

DECORTICATING, CARDING AND COMBING MACHINE.—J. F. LAFONT, 1335 Moss St., New Orleans, La. This invention provides a combined decorticating, combing, and carding device in one machine, thus doing away with the necessity of additional apparatus. It provides a device having opposed rows of teeth adapted to be moved simultaneously toward or away from each other, said teeth being mounted so as to have also a simultaneous bodily movement.

FOLDING UMBRELLA.—E. T. BLYTHE, Allen, Kan. One of the principal objects of the invention is to provide an umbrella having an improved rib and stretcher mechanism adapted to be folded inwardly against the stem, and when so folded to occupy a space of a length substantially equal to half the length of the ribs when extended.

SAW FILING MACHINE.—F. WILLIAMS, care of Jno. Hogan, 1904 Cumberland St., Little Rock, Ark. The present invention has reference to saw filing machines and more particularly to machines for sharpening gin saws and the like, and has for an object the provision of a means whereby the file carriage is automatically from one saw to another.

BELT DEVICE FOR CURD-MILLS.—H. W. QUADE, Kewaskum, Wis. The main object here is to provide means whereby a power driven mill may be moved to any desired point along the length of the vat, without interfering with the power connections, thus overcoming the present loss of time, inconvenience, and expense, due to the necessity for carrying the curds to the mill instead of, as in this invention, carrying the mill to the curds.

SHAFT FOR PAPER ROLLS.—G. F. PICKETT 4116 Fifth Ave., Brooklyn, N. Y. The inventor provides a pair of cones for coöperation with the shaft, said cones being movable freely inwardly from the ends of the shaft into engagement with the roll of paper, and each of the cones being provided with a dog or pawl coöperating with a toothed portion of the shaft to prevent accidental outward movement thereof.

GEAR SHIFTER.—C. B. BAUGHN, Sec. 25, D., Coalinga, Cal. This invention relates to means for shifting the transmission gears between an internal combustion engine and the point of power application, and is particularly adaptable for use on automobiles, one of the main objects thereof being to actuate the shifting means through the medium of the suction in the intake manifold of said engine.

FINDER FOR CAMERAS.—M. J. VINIK, 207 W. 109th St., New York, N. Y. The invention relates more particularly to a finder whereby the photographer can obtain a view of a subject being photographed simultaneously with the taking of the picture, the invention being especially useful in moving picture machines, although it is not necessarily limited to this use.

Musical Devices

ZITHER ACTION.—C. HABERMANN, Ferry St., Jersey City, N. J. The improvement relates to zithers and similar musical instruments, and provides an action arranged to permit the player to readily sound simultaneously a series of bass or accompaniment strings to produce the desired chords in a very simple and effective manner.

REPEATING DEVICE FOR PHONOGRAPHS.—W. E. CLEVELAND, care of Cote Piano Mfg. Co., Fall River, Mass. The inventor provides a device easily set for various-sized disks and arranged to automatically swing the tone arm upward at the time the stylus reaches the end of the sound groove to lift the stylus out of the said groove, to then swing the tone arm outwardly and then downward into active position relatively to the record to engage the stylus with the beginning of the sound groove.

KEY ZITHER.—L. JOST, 87 Ferry St., North Bergen, N. J. This invention relates to zithers and similar instruments in which the strings are operated by key actuated hammers. The invention simplifies and improves the construction and operation of instruments of this character so as to be comparatively simple to manufacture, reliable and efficient in use, and of durable and substantial design.

Prime Movers and Their Accessories

PISTON.—J. T. KING, care of Grand Forks Hotel, Grand Forks, B. C., Canada. This invention has reference to pistons for gas, steam, or other engines, pumps, compressors, etc., and the main object is the provision of a self-packing piston to replace the type known as ring pistons, whereby the greatly sought for lightness in pistons is assured.

INTERNAL COMBUSTION ENGINE.—L. V. LAURENTS, Lake Arthur, La. The principal object of this invention is to provide a crank shaft for an engine, which is of such a construction that it may perform the functions of the usual fly-wheel and in doing so, to permit the building and operating of the engine with the usual fly wheel omitted.

VACCUM OPERATED LIQUID FUEL FEEDING DEVICE.—E. R. HAWLEY, 211 Scott Bldg., Salt Lake City, Utah. This invention relates to a means for feeding liquid fuel to an internal combustion engine, and particularly to a feeding device for the indicated purpose, the operation of which is controlled by the suction produced by the engine when in operation.

ENGINE.—H. G. MORTIMER, 67 W. 71st St., New York, N. Y. The invention provides an engine the rotary valves of which are relieved from pressure during the explosion and compression. It also provides an engine having a secondary piston in each of the cylinders operated by an independent crank shaft, which crank shaft is synchronized in its movement with the crank shaft of the engine.

ENGINE.—J. L. HART, Chickasha, Okla. This invention provides a simple, compact and durable engine of the fluid pressure operated type, wherein stuffing boxes, eccentric rods and the like are dispensed with, the supply of fluid to the engine and the exhaust being controlled by the pressure on the cylinder.

ROTARY ENGINE.—E. F. O'HAVER, Box 331, Carlisle, Ind. This invention provides a rotary engine which is simple and durable in construction and arranged to permit of regulating the gas and air for the explosive mixture to a nicety and to insure the admission of the explosive mixture into the working chamber of the engine at the proper time.

Railways and Their Accessories

POWER BOND DRILLING MACHINE.—J. C. PARNELL and C. L. PARNELL, Montpelier, Ohio. This machine drills holes in railway rails for bonding the rails. A wheel carriage of light construction is adapted to travel on the track rails and from which carriage, a drill frame is suspended being pivotally hung at one end and disposed transversely of the carriage, the opposite end of the drill frame having left means whereby to raise and lower the same to a lowered position resting on a rail for drilling the latter or to a raised position clear of the rails.

COUPLING.—J. P. METZGER, Carlstadt, N. J. This improvement provides a coupling more especially designed for coupling a supply pipe to the injector of a locomotive and arranged to enable the engineer to readily manipulate the locking device for locking or unlocking the key section of the locking ring.

AIR BRAKE ATTACHMENT.—M. I. FLOWERS. Address, Archie P. Sale, Box 243, Waelder, Tex. In this case the invention is an improvement in air-brake attachments, and has for its object to provide mechanism for use in connection with railway cars for automatically controlling the air brakes to cause the same to be applied when a track is derailed.

Pertaining to Recreation

PUZZLE GAME.—L. J. HABERKORN, Chatsworth, Ill. This invention relates to games and toys and has particular reference to a game in the nature of a puzzle, comprising a tray having a flat bottom upon which are loosely and movably supported a plurality of traps or pockets and a plurality of differently-colored balls.

WHEELED FIGURE TOY.—L. MORSE, care of Rite Specialty Co., 35 W. 36th St., New York, N. Y. Among the objects of this invention is to construct a toy of unusually attractive appearance the same having the property of causing the rotation of a portion thereof around a vertical axis coincidentally with the the translation of the device along a horizontal surface.

Pertaining to Vehicles

DESIGN FOR A LIGHT FIXTURE.—S. TEPPER, 69 Wooster St., New York, N. Y. The plan and side views of this design show a circular fixture of simple and beautiful lines with attractive ornamental features.

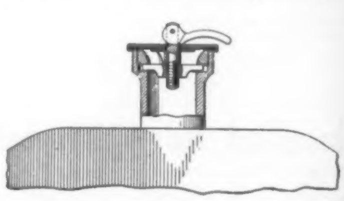
CONTROLLING LEVER LOCK.—E. L. McMANUS, JR., and C. A. SCHULTZ, JR., 109 E. 15th St., New York, N. Y. The invention refers to locking means for controlling levers, and has reference more particularly to locking means

CONTROLLING LEVER LOCK

for controlling levers of electric motors for vehicles. It provides a simple, easily operable and inexpensive lock for a controlling lever whereby the lever may be locked in a neutral position when the vehicle is at rest.

DRIVING MECHANISM FOR TRACTORS. —A. R. OGBURN, 927 Walker St., Des Moines, Iowa. The purpose here is to enable the operator to handle the tractor by the aid of a single hand lever, under such conditions that the operator can readily change the speed of the tractor, whether the machine be traveling forward or backward, and can also reverse the direction of travel, all by the manner in which he manipulates the single-hand lever.

RADIATOR CAP.—N. DUBOIS, R. 3, Box 99 Santa Ana, Cal. This invention provides a cap which may be readily put in place upon the stem of the radiator, and which may be adjusted for securely sealing the stem against leakage. The cap is in the form of a gasket adapted to be se-



RADIATOR CAP

cured upon a radiator stem and adapted to be engaged by a cross piece carried by a shaft, on which is provided a closure or plate fitted with suitable gaskets and adapted to be clamped into engagement with the stem through the medium of a cam lever for securely sealing the stem.

VENTILATOR ATTACHMENT FOR WIND SHIELDS.—F. A. SMITH, 4 Snyder St., Orange, N. J. This invention provides means for causing air to circulate around the feet of the occupants in the front seat while the car is in motion, this being accomplished by a ventilator which is positioned between the bottom of the wind shield and the top of the dash, so that the air enters between the wind shield and dash and is directed downwardly behind the latter upon the feet and then rearwardly, upwardly and out of the car.

SAFETY DEVICE FOR AUTOMOBILES.—H. WEINBERG and C. WEINBERG, care of Max Schenkman, 27 Cedar St., New York, N. Y. This invention provides an arrangement which will prevent the automobile from running over a person or any other large object. It also provides a guard which will prevent a person struck by an automobile from falling beneath the wheels.

WHEEL.—H. J. BOUDREAUX, care of Jos. H. Loeb, Morgan City, La. This invention is especially adapted for motor vehicles, wherein the wheel is so arranged that shocks and jars imparted to the rim or tire will be neutralized or absorbed and will not be transmitted to the body of the vehicle, the cushioning mechanism being interposed between the hub and the rim in such manner that either compression or tension stress will be counteracted.

Designs

DESIGN FOR A TOBACCO PIPE.—J. A. BERCHTOLD, Sigel, Ill. In this ornamental design for a tobacco pipe the form is very graceful in outline and the novel feature resides in the bowl of the pipe lying between outspread wings of a bird, whose head points away from the stem and mouth piece.

DESIGN FOR CRETONNE OR OTHER TEXTILE FABRIC.—M. W. RYAN, 395 Broadway, New York, N. Y. In this ornamental design the artistic features comprise alternate bands of white and stippled fields decorated with baskets of flowers leaves and branches.

DESIGN FOR A CANOPY FOR GAS AND ELECTRIC FIXTURES.—B. SCHWARTZMAN, 160 John St., Brooklyn, N. Y. In this ornamental design for gas and electric fixtures the canopy is circular at the top and from that center extends downwardly a short round portion prettily ornamented at the tapering end, the whole having almost a T-shape in perspective view.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.

The Mechanics of Marching

(Concluded from page 551)

To sum up then: The gun should be carried with its center of gravity just a wee bit behind the shoulder so as to balance the weight of the hand and forearm which keeps it steady (this is the usual practice, be it said); the pack should be as compact as possible, close-fitting to the back, the heavy articles tightly packed in the lowest available space; no swinging articles should be allowed, not even tassels; the coat across the breast should be loose-fitting, as should also the underclothes; a slow gait should be used; as small a rise and fall as possible of the body should be indulged in, and as short a sway as possible. To the above may be added that the shoes should not have stiff soles, for every time the sole of a shoe is bent energy is used up.

To decrease the rise and fall of the body in walking the old "Indian walk" used by some surveyors is useful. It consists in slightly crooking the forward knee as the body is shoved forward onto the front foot. After a little practice, this habit is soon acquired, and it certainly decreases the amount of energy used up per step.

Once upon a time an officer in the army, when called upon, along with others, to make suggestions for the efficiency of the infantryman, sent in a suggestion that the whole pack and outfit of a foot-soldier be placed in a little express wagon, such as boys delight in, and that the tongue of this wagon be attached to the soldier's belt behind. The officer came very near being courtmartialed, but he had the right scientific idea. The wagon certainly would not bob up and down and thus consume energy when rough places were encountered.

Rubber heels also lessen the amount of energy used up, by giving back, as the foot is lifted, part of the energy used to compress them. They also serve another purpose. Somewhat technically, it is this: if a certain momentum is to be created or overcome, the longer the time given to do it the smaller the force required. It is easiest to illustrate this in the case of the automobile. It is very heavy and so, when a wheel rolls over a brick and falls down on the other side, it would have an enormous momentum (momentum is simply the product of the mass and velocity). Sir Isaac Newton told us that mass times velocity—that is, momentum—equals force times time. So, with a given momentum, as that of the automobile falling off the brick, the product of the force that overcomes this momentum, and the time through which it operates in doing so, is constant. The greater the time, the smaller the force; but the smaller the time, the greater the force.

Then, if the automobile had iron tires and no springs the time of destroying the momentum would be almost infinitesimal, that is, it would hit and stop suddenly, and the force necessary to satisfy the equation $M = f \times t$ would be very great. In fact it would, without doubt, be great enough to break the axle. But what actually is the case? The air in the tire is compressed more or less slowly, and the time is an appreciable fraction of a second, so the force against the axle is correspondingly small.

The same actual amount of work is used up in each case, but the force is different. The bearing of these remarks upon rubber heels is obvious.

This same thing is true of the shoulder and the gun: The shoulder rises up suddenly against the gun and a big force is created. The shoulder gets sore. And a sore-shouldered soldier easily persuades himself that he is dead tired. Now, it is compulsory in the Army for soldiers to use pads on the rifle range where the gun kicks against them when it is fired. Why, oh why, are not the pads used on the march, where, although the force is smaller, it certainly tells in the long run?

Every time clothes have to be stretched as one walks, energy is used up. Clothes made out of non-stretchable materials, such as khaki, and fitting loosely, would thus save energy; for if they were tight at any place, that place would soon be pulled out loose, and the constant pulling and flying back again would be avoided.

The Romance of the Unsuspected

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irregular about the method and results of the analysis of the gas. Then, on making a careful and complete analysis, Professor Langdon found that this same poisonous gas—poisonous to animals—was contained in this sea-weed gas in quantities from one to twelve per cent. And this is no small quantity, for it was enough, not only to show all the chemical tests, but it was enough to kill canaries, chickens and guinea pigs, when placed in the gas. Of course the gas was drawn off from the seaweed in large quantities; and its identification is beyond dispute. Professor Langdon has placed the whole world of both chemists and curiosity hunters under lasting indebtedness for his novel and surprising, and yet wholly natural, discovery. It is gratifying to know that Mother Nature does not only use and make, but also that she actually stores up, notable quantities of this paradoxical gas, carbon-monoxide. This is said to be the first time that such an occurrence has been noted for the vegetable world; and yet, most of us might say: "Well, why not?" Of course, but all the same, it is a decided step in "The Advancement of Learning."

Submersible the Ultimate Answer to the Submarine

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steam plant for running through the danger zone.

Although capable of navigating at submerged depths of from 50 to 100 feet the *first cost* of this vessel differs little from that of the ordinary surface type of ships. Furthermore, the ships are so constructed that, when the war is over, they can be converted into surface ships by the erection of a central tier of deckhouses for the accommodation of the officers and crew.

The low speed of 8 knots can be secured with engines of 1,600-horse-power. The motive power consists of water-tube boilers and triple-expansion, condensing engines, which drive the ship when running on the surface. For undersea running the thermal storage system is used. This consists of large hot-water storage tanks, maintained at boil r temperature and pressure. In submerging, the oil burners are shut down, the hinged smokestack covers clamped in place and steam is drawn from the hot water in the tanks, which continues to boil under the constantly reducing pressure. This method was used successfully on a street car system in Paris, several years ago. These were steam cars, in which the boiler was replaced by a hot water tank, charged with water under high pressure and temperature at the commencement of each run.

The system was used about thirty years ago in the British submarine "Nordenfeldt" and operated successfully as a mechanical proposition. It was abandoned because the radiation from the tank made the interior so hot that the crew were incapacitated. Mr. Bright avoids this by adopting the "thermos bottle" principle. He encloses the tank in an outer shell from which the air is exhausted.

In a submersible of this length (410 feet) it would be dangerous to dive; because the bow might readily descend to depths at which the water pressure would cause collapse. Submerging will take place on an even keel, and to this end eight hydroplanes of large area will be provided.

Ordinarily the ship will steam in the awash condition with only the deck and conning tower exposed. In the submarine zone she will proceed awash with only the conning tower exposed. In this condition she will be difficult to detect from the deck of an enemy submarine. On sighting an enemy submarine, she will descend and show only her periscopes, and because of her slow submerged speed of 5 knots, the wake will be scarcely discernable. Should she be sighted, she would submerge, change course and escape.

The danger of being attacked by friendly patrols would be small; for the U-boat is seeking the enemy and constantly running into danger, whereas the freighter would be avoiding danger and constantly running away from it.

How Salt Water Climbs the Miraflores Locks

(Concluded from page 551)

Ten sampling stations were established in the sea gates, the lock chambers, and the lake, as shown in the diagram.

Samples were taken from a small boat and analyzed immediately. Specimens of water were taken at the bottom of the chambers, at mid-depth and at the surface; and both before and after the horizontal and vertical movements of the water surface incident to lockage.

When the lower gates are opened, although the water level within is approximately the same as without, there is at once set up a heavy current running out to the sea on the surface and a corresponding current on the bottom running into the lock chamber. At high tide this action is sustained for a period of approximately twenty minutes.

Referring to the figure the first samples were taken at station No. 1 immediately before the lower gates were opened. The salinity was practically uniform from top to bottom and the chlorine content in parts slightly less than in normal sea water. The lower gates were opened and after a period of fifteen to twenty minutes closed, then samples were taken at stations 2, 3 and 4, bottom, mid-depth and top. The range of chlorine content is shown to have been from approximately twenty thousand parts on the bottom to approximately twelve thousand parts on the surface.

Water was then drawn from the bottom of the upper chamber and admitted by means of the longitudinal side wall culvert to the lower chamber through vertical openings in the floor. This equalized the water level in the two chambers, and the chlorine content of the surface and bottom layers of the lower chamber more nearly coincided, indicating the mixing effect due to the water from the upper chamber being projected upward through the denser water of the lower chamber during equalizing.

Before the gates between the two chambers were opened, samples were taken at stations 5, 6 and 7 and the water was found to have a more or less uniform salinity from top to bottom as expressed by an approximate mean chlorine content of 4,000 parts per million. The gates were then opened and after the currents had subsided samples were again taken at the same stations. The tendency of the waters of different salinity in the two chambers to stratify rather than to mix as during filling, is indicated by the chlorine content at the bottom, mid-depth and surface, as shown in the figure for these samples.

Lake water was then admitted to the lock chamber through the vertical openings in the floor and the level raised to that of the lake. Samples were again taken at stations 5, 6 and 7 and showed the chlorine content to range from approximately 6,700 parts per million on the bottom to 5,000 parts on the surface.

The gates leading into the lake were then opened and currents resulted running into the lock chamber on the surface and out into the lake on the bottom. After these currents subsided samples were again taken at the same stations and also out in the lake along the center approach wall at stations 8, 9 and 10. The water in the lock chamber was found to have remained at practically the same salinity on the bottom below the gate sill as before the opening of the gates. But the average mid-depth and surface density decreased materially.

The samples taken tend to confirm the theory that, during filling, when water is admitted from the upper chamber to the lower, more or less intimate mixing of the waters of two densities takes place, tending to result in a chamber content of uniform density. When the gates separating the chambers are opened the denser water in the lower chamber lying above the level of the lower sill of the upper chamber rushes forward into the upper chamber displacing the fresher water which runs back into the lower chamber on the surface, thus giving a condition approaching stratification, the fresher water lying on top and the denser salt water lying upon the bottom.

The Modern Torpedo

(Concluded from page 549)

may be passed in order to bring the gyroscope into alignment with the spinning mechanism. The finger openings are normally closed by a cover plate 65 held tightly against the lower part of the sub-casing or frame 61, so as to make a watertight joint. The hand plate 67 is held in place on the same principle as that employed in the construction of breech blocks of guns. In other words, the principle of the mutilated screw is employed so that the hand plate is first forced into position and then given a short turn in order to lock it in place.

On the turbine shaft 69 the turbine wheel 70 is keyed—the rotor of the turbine. Air is supplied to the turbine wheel 70 through the pipe 54 and the nozzle 71. The shaft 69 revolves in a sleeve 72 within a casing 73, provided with a slot 74. An arm 75 fulcrumed at 76, engages trunnions 77 on the sleeve 72. A coil spring 78 is attached at one end to the arm 75 and at the other to the bracket 79, which is of course a fixture. A valve is provided at 76 to control the flow of air through the nozzle 71. In Fig. 5 the valve is open so that air may flow when the starting latch is pulled. The turbine shaft 69 carries a long pinion 80, which meshes with the gear 81, on the shaft of which is mounted a worm 82 engaging the worm wheel 83. This worm wheel 83 carries an eccentric 84. By means of the connecting rod 85, the eccentric causes the rocker plate 86, which carries a pawl 87, to engage the racket 88. This ratchet 88 is integral with the cam 89, the surface of which engages a pin 90.

On the outer end of the turbine shaft 69 is a gear 91 meshing with a similar gear 92 on the gyroscope flywheel shaft. The gimbal ring 57 is locked in position by means of a pin 93, which falls into a recess and holds the gimbal ring in place, while the gears are in mesh and the gyroscope is being spun. In order to bring the gears 91 and 92 into mesh and the pin 93 into engagement with the socket in the gimbal ring 57, the stud 94, which carries the ratchet and cam 88 and 89 is revolved. As a result the pin 90, and consequently the lever arm 75, will be swung over into the position shown and will be held there by the surface 89a of the cam. As the turbine 70 is revolved and consequently the pawl carrying the rocker plate 86 is operated, the cam 89 will be moved around until the pin 90 is released from the face of the cam through the medium of the spring 78. The lever 75 will snap out of the position shown in Fig. 5, carrying with it the sleeve 72 and the shaft and gear 91.

The pin 93 must be withdrawn, however, before the gyroscope is completely released. The pin remains in engagement with the gimbal ring until the gears 91 and 92 are entirely out of mesh. It is withdrawn by the movement of the stud 94. Lost motion is provided between the movement of the sleeve 72 and the pin 93, so that the gears can be drawn out of mesh before the pin itself is withdrawn. The air which was supplied through pipe 54 must not continue to flow from the tank after the gyroscope has been released, and consequently it is cut off by the valve 76. When the trunnion 77 reaches the end of its travel in the slot 74 the valve carried by the fulcrum 76 is completely closed.

Several methods of transmitting motion from the vertical gimbal ring 59 to the rudder-actuating mechanism are in use, all differing considerably from a mechanical standpoint, but having the common purpose of accomplishing the desired action with as little effect as possible on the gyroscope itself. In the detail view appearing in the upper left-hand corner of Fig. 5, a typical mechanism is shown to convey motion from the gyroscope to the valve gear or the servo motor 23a (Fig. 4). The disk 59a is provided with a single tooth and is securely fastened in the gimbal ring 59 so that it may rotate therewith. The lever 97 is provided with the equivalent of two gear teeth and may be engaged by the tooth on the disk 59a. The lever 97 is attached to a vertical shaft 96, having a small crank 96a at its upper end, attached to which is the piston valve 96b, which slides in the valve casing 96c. This valve is of the

balanced type and requires very little power to move it. When the lever 97 is engaged by the disk 59a, the valve will be drawn in or out, depending upon the side to which the torpedo swings around the gyro. In the servo motor 96d (a small air cylinder) a piston is forced in or out, according as the valve opens one or the other of the ports. To the piston rod 96e of the servo motor a steering rod is attached, which runs to the tail of the torpedo and is there connected with the steering rudder crank.

If in steering the weapon is made to over-run the course on the opposite side, the helm is reversed, the operation being repeated until the normal course is followed. The swing of the rudders of a torpedo is very short, and consequently the weapon does not deviate normally very far from either side of the line.

By constant refinement, the gyroscopic steering gear has kept pace with the growing demands which have been made upon it. The United States Government is now having weapons 21 inches in diameter and 21 feet long made—weapons credited with a speed of 40 knots and with a possible range of some 10,000 yards. Except for the introduction of means for spraying water into the superheated air chamber, thereby augmenting the supply of motive fluid available for propulsion, the main principles involved in the design remain practically the same.

Torpedoes, as we have here described them, have their limitations, particularly as weapons for battleships which fight at ranges of seven miles or more. In the first place it must be noted that the torpedo gyroscope persists in its plane of rotation only so long as its velocity of spin is sufficiently great. Hence in all impulse type of gyroscopes—the type previously described and the only type in use—where energy is applied to the flywheel and subsequently cut off so that the wheel may freely revolve by its own momentum, the speed of rotation gradually decreases with the result that as the torpedo nears its mark, the stored energy becomes less and less. Just when the efficiency of the gyroscope should be at its highest, it is at its lowest. No wonder that in long range torpedo firing the gyroscope becomes sluggish, and even "dies" before the weapon reaches its mark. The gyroscope should maintain a practically constant velocity of rotation throughout the period of the torpedo's run. To accomplish this with an impulse spun gyroscope would necessitate the use of such a large flywheel that external auxiliary means would have to be provided for spinning the wheel.

Now that battle ranges have increased beyond the distance at which a gyroscope can be really effective, it is obvious that improvements of some kind are called for. That accounts for radio-control, sound control, and similar schemes. It has been proposed to supply compressed air continuously to the gyroscope for the purpose of maintaining a maximum spin. But if this is done the air must be conveyed to the flywheel in such a manner that when the gimbal rings are free there can be no tendency for the air to disturb the delicate balance of the apparatus. The air would have to be conveyed through one of the pivots supporting the fly-wheel gimbal ring. While this may be accomplished, a high degree of mechanical perfection would be demanded if leakage of air is to be prevented, and the present anti-friction pivot still retained. A more serious drawback is the amount of air that would have to be drawn from the main air supply to keep up the spin and the necessity of supplying an auxiliary air tank if some form of energy other than air were used for the engines.

If a gyroscope could be spun continuously by compressed air, certain difficulties would be encountered, very prominent and troublesome among which is that resulting from what is known as "wire-drawing" of the air, which is liable to set up a freezing action and which in the case of a gimbal pivot would greatly increase its friction, so that it might prove worthless as an anti-friction device.

The present type of torpedo, equipped with an impulse gyroscope, is open to the objection that the operation of starting

the engine does not unlock the gyroscope, but merely starts the spinning turbine. By the time the spinning impulse is completed, the torpedo may have veered around, and when the gyroscope is finally released, it may not be pointing in the right direction.

In about one-tenth of a second it is necessary to store sufficient energy in the gryo-wheel to maintain an effective spin; although a powerful impulse can be impressed upon the wheel, certain factors tend seriously toward militating accuracy in shooting. If, for instance, there is any deviation in the pointing of the launching tube at the moment the gryoscope is unlocked, the resulting direction will not be in the true line of sight and the weapon may go wide of its mark. If, on the other hand, the unlocking period is too short, the duration of the spin will suffer.

Again, high speed is obtained at a sacrifice in the range of the torpedo and *vice versa*. The limitations of the present principles of construction are in plain view. In apparent anticipation of this end, inventors have gone faithfully to work devising new methods of propulsion which they believe will produce better results without modifying the general proportions of the present weapons.

Aside from the high initial expense of the compressed air torpedo ($7,000 is the cost of such a weapon) its subsequent charging and recharging is also expensive, when we figure the power expended over a given period of use. Hudson Maxim proposed the use of a self-combustive composition—a slow-burning powder—which was intended to overcome this wastage. In his weapon a slow-burning charge of a specifically prepared explosive material was ignited in a chamber into which water was injected. Steam was generated which, mixing with the products of combustion, formed the motive fluid. The principle is extremely interesting, but the difficulty of controlling and governing the generation of energy in such a system must always be formidable.

A serious obstacle in the path of those who would depart from the old method of propelling torpedoes by employing gasoline engines, lies in the fact that the torpedo, running as it does several feet under water, must carry its combustion supporting medium. To employ a hydrocarbon engine means the carrying of air or its equivalent, in sufficient quantities to provide a proper mixture of the gas in the engine. It has been proposed to compress air, or better still, oxygen, permitting it to enter a mixing valve, together with the hydro-carbon in measured quantities. To adjust the mechanism to such a nicety that it will automatically give a proper explosive mixture at each stroke is a great difficulty. Variations in temperature, variations in the condition of the fuel, variations in the pressure when delivering the gas or air, all tend to make the problem of driving a submarine torpedo by an internal combustion engine extremely perplexing. Moreover, it must not be forgotten that to drive a large torpedo at the necessary speed requires energy enough to develop approximtaely 125 horse-power for 15 minutes. If a hydrocarbon engine is to be used, we still have the compressed air or gas tank—smaller and working at less pressure to be sure—but still there. Much smaller, however, it can hardly be, particularly if the supply of gas is also to be depended upon for self-starting and for additional energy.

It is obvious that this whole problem is one of propulsion. At present high speed is obtained at a sacrifice in the range of the torpedo and *vice versa*. What is wanted is a method of propulsion which can be brought into action on short notice.

'*The warhead of the torpedo with its charge of high explosive is shown in Fig. I. It is detonated by means of a firing pin and a primer. Normally the pin is locked in the safety position by a nut; but when the topedo is fired, the water causes the little propeller shown at the entrance point of the warhead to rotate and unscrew the nut, leaving the firing pin free to be pushed back when the torpedo strikes the side of the ship, thereby detonating the charge.*—EDITOR.'

How the American Artists Are Helping Their Navy

(Concluded from page 552)

England, assistant to the great Brangwyn, is to splash paint which will make the passers-by of Boston stop and look at the billboard appealing for recruits. And in Pittsburgh, Edward Trumbull, another Brangwyn-trained painter, is delineating a design which will carry out the idea of the Pittsburghers:—"Those of you who are not making steel, make history, and enlist in the Navy." Also, in New Bedford, C. W. Ashley, the whaling artist, is painting blue seas to teach the corner loafers of New Bedford to drop their chewing gum, enlist in the Navy, and be a man.

And right in the heart of cubism, at Twenty-third Street and Fourth Avenue, James Daugherty, another Brangwyn lad, pale-faced and worried, is trying to make a smashing poster which will pass the eagle-eye of the Commander and also stop a clock and make a few men want to go in the Navy. Willy Pogany, once an Austrian, now an American, is also working. The patriotic fever has even struck the sculptors and on the cliffs of Weehawken, Robert Aitken, now in the Officers' Reserve, is thinking hard about the billboard which he is going to paint for the Navy, and so is Mahonri Young. George Bellows' powerful brush is also for the Navy, and Arthur Crisp has forsaken his graceful lyrics for the sterner themes of gun and barbette.

In the wilds of Connecticut, George Wright, and E. M. Ashe are to convince, by brush and paint, that the place for a young man is now in the Navy. And George Beal, the impressionist painter of New York, has also set aside his Spring canvasses to give the fleet a helping hand. And, in the same way, Jean Paleologue, known in New York's Bohemia, as "The Prince," is putting his French enthusiasm behind his brush strokes in welding a design for Navy recruiting. Likewise, A. S. Covey, the Mural decorator, also an artist trained in Brangwyn's studio. It seems as if a lot is coming to Brangwyn.

This does not only cover the patriotism of artists, but translated into dollars and cents, the billboard people are in the movement to help the Navy, to the extent of thousands of dollars. The billboard at Times Square on which the writer painted a thirty by forty foot recruiting design of a battleship in action was presented to the Navy by the O. J. Gude Company, and that little patch represents $400 a month, in rentals. W. H. Stayton, Executive Secretary of the Navy League, is obtaining billboards throughout the country and the decorators of the Middle West and California are all being enrolled to help Navy recruiting.

The Leyendeckers head the list of the poster men who have volunteered their services, and Charles Dana Gibson, the dean of the corps, carried his own drawing under his arm down to Captain Bennett's office, and our only James Montgomery Flagg swung his racing car into the wilds of Thirty-ninth Street on the edge of Hell's Kitchen, where the Navy does its publicity and unloaded a perfectly ripping and live oil painting which is now in the hands of the lithographers. Jules Guerin, who is doing the murals for the Lincoln Memorial, has also responded to the call and is about to design a Navy poster, and so is Herbert Paus, Tony Sarg, the British Artist, William Fosdick and Charles Chapman. And, as a marine artist, W. J. Aylward has forsaken his square riggers and is thinking about submarine chasers and motor boats in the making of a design for recruiting.

Way out in Bellport, on Lond Island, Mrs. May Wilson Preston is taking a rest, while she is contemplating how to represent the women's view and the girl's choice between the "slacker" and the fellow who enlists. Howard Chandler Christy, and Howard Giles are now on the job. Kenyon Cox, America's classic mural painter, whose decorations adorn our public buildings, has probably contributed the most distinguished poster of all. It has the touch of the great Puvis de Chevanne.

Just now, in these United States, no art counts unless applied for recruiting.

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